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SERIES A: AGRICULTURAL

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REVIEW
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SERIES A.

Vol. 44. 1956.

SALT (G.). **The Arthropod Population of the Soil under Elephant Grass in Uganda.**—*Bull. ent. Res.* **46** pt. 3 pp. 539–545, 9 refs. London, 1955.

Since elephant grass (*Pennisetum purpureum*) is the natural vegetation of large areas in the cultivated districts of Uganda and often occupies the soil between periods of cultivation when shifting agriculture is practised, information was sought on the arthropod population of soil under it. This was obtained by taking cylindrical samples of soil 4 ins. in diameter and 6 ins. deep, to a depth of one foot, and extracting the arthropods by wet sieving, flotation in a solution of magnesium sulphate, and separation at a benzene-water interface [*cf. R.A.E.*, A **32** 306]. Samples were taken for comparison from soil under cassava [*Manihot utilissima*] and from fallow soil.

The following is based on the author's summary of the results. The arthropods extracted from six soil samples from elephant-grass leys represented a population of 87,147 per sq. metre in the top 12 ins. of soil, as compared with 26,150 per sq. m. from adjacent cultivated soil. The population in the top 6 ins. under elephant grass was estimated at 73,517 per sq. m., which is higher than that recorded for grazed pastures in East Africa [**40** 202]. The greater population under elephant grass is attributed to the crumb structure of the soil and the protection afforded by the grass against insolation. It is suggested that the nitrogen contained in the soil arthropods, especially that in the chitin and sclerotin of their exoskeletons. forms part of the nitrate that becomes available in the soil some weeks or months after elephant-grass leys are cultivated.

BANKS (C. J.). **An ecological Study of Coccinellidae (Col.) associated with *Aphis fabae* Scop. on *Vicia faba*.**—*Bull. ent. Res.* **46** pt. 3 pp. 561–587, 5 figs., 18 refs. London, 1955.

The following is based largely on the author's summary. The changes in numbers of adult Coccinellids on nettles (*Urtica dioica*) infested by *Macrosiphum* (*Microlophium*) *evansi* (Theo.) and on three experimental plots of field beans (*Vicia faba*) infested by *Aphis fabae* Scop. were investigated in April–October 1952 at Rothamsted by means of collection and release and counts on stem samples [*cf. R.A.E.*, A **43** 12], respectively, and collections made by means of suction traps situated at the level of the beans. Populations of *M. evansi* were large and well established by early May, reached

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a peak in mid-June and had almost disappeared by the end of that month. Primary migrants of *A. fabae* arrived on the bean plots in late May, and the percentage of infested stems on one that was very exposed was 54 by early June and the mean populations per stem more than four times as high as on a plot sheltered by trees and buildings. Populations reached peaks in early July in the heavily infested plot and in mid-July in the other two, and then declined owing to the departure of the alates and reduced reproductive capacity of the apterae.

The three common Coccinellids present were *Adalia bipunctata* (L.), *Coccinella septempunctata* L. and *Propylea quatuordecimpunctata* (L.), of which the first was the most abundant. Most of the overwintered adults of all these species produced a brood on nettles in the spring and another on beans in early summer. In the bean plots, increases in the number of adults took place in three phases. In the first of these, overwintered adults, dispersing from nettles and elsewhere, accumulated on the beans during the early stages of infestation by *Aphis fabae*; in the second, the progeny that had developed on nettle migrated to beans when populations of *A. fabae* were at a maximum, and in the third, the progeny that had developed on beans reached the adult stage at a time when infestation by *A. fabae* had ceased. Coccinellids were abundant at all times on one of the bean plots, and this was attributed to its position between two of the clumps of nettles; the other two plots were remote from nettles and showed much lower populations. The numbers of eggs and larvae on the bean plots followed the variations shown by the adult population, but there was no third phase of increase.

The larvae were frequently observed attacking the eggs of their own and the other species on the bean plot with the high Coccinellid population, and a loss of 56 per cent. of the newly hatched larvae in one week was also attributed to cannibalism. The evidence suggests that this was due partly to a scarcity of the Aphids, but chiefly to the great abundance of the eggs. It was influenced by the relative situations of the egg batches and of the Aphids on the stems; larvae dispersing after hatching probably encountered egg batches on the lower leaves more readily than Aphids at the tops of the plants. The very high Aphid population caused early defoliation of the plants on the exposed plot and the consequent accumulation of many of the predators in the ground litter. Many Coccinellid larvae from the numerous eggs laid during the second phase probably died of starvation towards the end of the infestation owing to the disappearance of many of the Aphids. The numbers of Coccinellid eggs and larvae on the different plots depended not on the size of the Aphid population but on the numbers of adult Coccinellids present on the beans, and the mortality rates of the immature stages were apparently not correlated with Aphid densities on the three plots. The main factors determining the adult population appeared to be the distance of the plots from nettles harbouring Coccinellids and the shelter afforded by trees and buildings.

Coccinellids were ineffective as predators of *A. fabae* because most of the overwintered adults and their progeny were attacking *M. evansi* on nettles when *A. fabae* arrived on the beans. When the Coccinellids migrated in numbers to the beans, the Aphid infestations had already reached their peak and the effect of the predators was slight.

KENTEN (J.). **The Effect of Photoperiod and Temperature on Reproduction in *Acyrthosiphon pisum* (Harris) and on the Forms produced.**—*Bull. ent. Res.* **46** pt. 3 pp. 599–624, 1 pl., 6 figs., 23 refs. London, 1955.

The following is based largely on the author's summary. The effect of photoperiod and temperature on the production of the various forms of

Macrosiphum (*Acyrthosiphon*) *pisum* (Harris) [*cf. R.A.E.*, A **31** 411; **40** 130] was studied by exposing apterous virginoparae on broad beans (*Vicia faba*) to daily photoperiods of 8 or 16 hours at temperatures of 5–9, 7–11, 11–13, 19–20, 25–26 or 29–30°C. [41–48·2, 44·6–51·8, 51·8–55·4, 66·2–68, 77–78·8 and 84·2–86°F.]. The Aphids originated from a stock that had been reared for many generations at 19–20°F. in continuous light. At each temperature, they were exposed either to the same photoperiod throughout their life or to one during the nymphal and the other during the adult stage. Their offspring were collected at intervals, reared under the standard conditions and examined.

The offspring produced comprised mainly apterous and alate virginoparae, males and oviparae. In addition, there was a subsidiary form of the apterous virginopara with sensoria on the hind tibiae. Sexual forms were produced at all temperatures below 20°C., but only by parents exposed to the short photoperiod during the nymphal stage; the photoperiod to which the parents were exposed when adult had no effect on the proportion of sexual offspring produced. Males were produced at 11–13°C. and 19–20°C., the highest proportion (20–30 per cent.) at 19–20°. Females were produced at all temperatures below 20°C., the highest proportion at 11–13°C., at which 56–80 per cent. of the total were oviparae. Alatae were rarely produced in large numbers. The highest proportion was produced at the lower temperatures by parents that were exposed to the long photoperiod throughout their life. The apterous virginoparae with sensoria on the hind tibiae were produced at all temperatures, mostly by parents exposed to the short photoperiod during the adult stage. Most offspring were produced at 19–20°C. The few produced at 29–30°C. frequently required an abnormally long time to develop and gave rise to small adults. The length of life of the parent adults increased as the temperature decreased.

PARKIN (E. A.) & BILLS (G. T.). **Insecticidal Dusts for the Protection of stored Peas and Beans against Bruchid Infestation.**—*Bull. ent. Res.* **46** pt. 3 pp. 625–641, 1 fig., 26 refs. London, 1955.

Attempts in East and Central Africa in recent years to export haricot-type beans and peas to Britain for canning and seed have been hampered because of infestation by *Bruchus* (*Acanthoscelides*) *obtectus* Say and *B.* (*Callosobruchus*) *chinensis* L. Laboratory tests were therefore begun on the protective value of mixing insecticidal or inert dusts with the seeds, since this would provide a cheap measure that could be safely and easily applied by unsupervised African labour. The insects used comprised adults of a laboratory stock of *B. chinensis* and of a strain of *B. obtectus* reared from a sample of mixed beans from Tanganyika. Peas and beans were shaken with the dusts, transferred to glass jars or small bags of hessian jute, and infested with known numbers of adults of *B. chinensis* and *B. obtectus*, respectively. The dead adults were counted three and six days after treatment and living adults of the next generation after about six and nine weeks.

The following is based on the authors' summary of the results. Both Bruchids were very susceptible to most of the materials tested. Adults of *B. obtectus* were in general the more resistant, but increase of this Bruchid was more easily prevented, apparently because of the vulnerability of the first-instar larvae before they enter the beans. It is concluded that peas and beans can be protected by thoroughly mixing into 200 lb. of the commodity 6–8 oz. colloidal silica, colloidal aluminium pentasilicate or finely ground diatomite, or the same quantity of diatomite or kaolin impregnated

with 0·05 per cent. γ BHC (as lindane) or 0·5 per cent. technical DDT. Rock phosphate or kaolin or talc alone were not effective. Lindane or DDT at the rates recommended are unlikely to taint the commodity or render it toxic to man or animals even if it is not subsequently cleaned.

HOWE (R. W.) & FREEMAN (J. A.). **Insect Infestation of West African Produce imported into Britain.**—*Bull. ent. Res.* **46** pt. 3 pp. 643–668, 8 graphs, 18 refs. London, 1955.

The following is based largely on the authors' summary. An analysis is made of the records of inspections for infestation by insects of 3,632 cargoes imported into Britain from West Africa in 1942–52. The exporting territories extended from Angola to Senegal, and most of the cargoes comprised produce from the Gambia, the Gold Coast, Nigeria and Sierra Leone, though imports from the French territories were received during the late war. Ships usually call at several West African ports on each voyage and each may carry many kinds of produce or load the same type of cargo at several ports. Insects readily spread from one cargo to another, and the type of infestation is therefore similar for all, but a few species are especially associated with particular crops. The three major products were cacao, kernels of the oil palm [*Elaeis guineënsis*], and groundnuts; the cacao originated principally from the Gold Coast and Nigeria, the palm kernels from Nigeria and Sierra Leone, and groundnuts from Nigeria. Groundnuts are usually shelled prior to export in Nigeria and French Niger, but not in Senegal, the Gambia or Portuguese Guinea; in Sierra Leone, some groundnuts are shelled and some are not. Unshelled groundnuts are normally shipped alone and are therefore relatively protected from cross-infestation. Lists are given of the species commonly found on all of 18 products examined and on the dunnage of ships' holds, as well as a list of all the insects found during inspection of the cargoes, with some estimate of their abundance in West Africa.

Twelve species infested over 10 per cent. of the cargoes of cacao beans; five of these were probably acquired from groundnuts and one from palm kernels by cross-infestation. *Ephestia cautella* (Wlk.), *Tribolium castaneum* (Hbst.) (from groundnuts), *Lasioderma serricorne* (F.), *Necrobia rufipes* (Deg.) (from palm kernels), and *Araecerus fasciculatus* (Deg.) all infested over 40 per cent. of the cargoes. Yearly fluctuations in infestation were similar among *Corcyra cephalonica* (Stnt.), *Plodia interpunctella* (Hb.), *Tenebroides mauritanicus* (L.), which is partly predacious, and *Oryzaephilus* spp., these being the other species acquired from groundnuts. Variations in the frequency of other species appeared to be unrelated. Nearly all the insects, including *A. fasciculatus* and *L. serricorne*, but not *E. cautella*, were scarcest towards the beginning of the seasons of both the main (December) and light (May) crops and commonest at the end of each. *L. serricorne* and all the species acquired by cross-infestation also showed a peak of infestation in July, the cause of which is uncertain.

Nine species, five of them mainly acquired from groundnuts, were found on over 10 per cent. of the cargoes of palm kernels. The most numerous were *N. rufipes*, *Tribolium castaneum* and *E. cautella*, which each infested over 75 per cent. of the cargoes, and *Oryzaephilus* spp., which infested 35 per cent. *N. rufipes*, *A. fasciculatus*, *Ahasverus advena* (Waltl), *Carpophilus* spp. and *L. serricorne*, which are typical of the humid zone, showed similar fluctuations from year to year, but those for *Oryzaephilus* spp., *Tenebroides mauritanicus*, *Corcyra cephalonica* and a species of *Laemophloeus* tentatively determined as *L. ferruginеus* (Steph.), all of which may have spread

from groundnuts, were less consistent. There was little evidence of a seasonal variation in numbers on this product.

Ten species infested over 10 per cent. of the cargoes of shelled groundnuts, but only two, *A. advena* and *N. rufipes*, were acquired in transit through the humid ports. All but one infested over a quarter of the cargoes, and *Tribolium castaneum* was found on nearly every cargo. Variation in infestation from year to year was fairly similar in the eight main species, but seasonal variation was not clear, owing to the overlapping of the storage periods of successive crops. Groundnuts were much more heavily infested than the other two major crops, and infestation by *T. castaneum* was almost always medium or heavy in intensity. Eight species were found on 10 per cent. or more of the cargoes of unshelled groundnuts, and *Pachymerus* (*Caryedon*) *fuscus* (Goeze), *T. castaneum*, *E. cautella*, *Corcyra cephalonica* and *T. confusum* Duv. infested over 40 per cent. of the cargoes. Beetles increased in abundance towards the end of the season (May), but moths were most frequent in mid-season (March–April).

Numbers of almost all the species infesting groundnuts declined in 1951 and 1952, and this is attributed to the combined effect of a reduction in the period of storage and the introduction of chemical control measures against *T. castaneum* and *Trogoderma granarium* Everts in Nigeria [*cf. R.A.E.*, A **40** 265], but nevertheless heavy infestations by *Tribolium* became more numerous from April 1948, and fumigation of cargoes against *Trogoderma* was necessary each year, though infestations were smaller and less frequent in 1951 and 1952.

The results of inspections of cargoes of the same products in 1953, mainly from Nigeria, are reviewed in an appendix. In general, the frequency of occurrence of all species was similar to or lower than that noted in previous years, but *N. rufipes* and *T. granarium* were both more frequent on groundnuts. On cacao, *Lasioderma serricorne* appeared to be commoner in Nigeria than in the Gold Coast, and *Araecerus fasciculatus* in the Gold Coast than in Nigeria.

HANNA (A. D.), JUDENKO (E.) & HEATHERINGTON (W.). **Systemic Insecticides for the Control of Insects transmitting Swollen-shoot Virus Disease of Cacao in the Gold Coast.**—*Bull. ent. Res.* **46** pt. 3 pp. 669–710, 2 pls., 3 figs., 11 refs. London, 1955.

The following is based on the authors' summary. The swollen-shoot virus of cacao is transmitted in the Gold Coast by mealybugs, of which *Pseudococcus njalensis* Laing is the most important, and these are tended by ants of the genus *Crematogaster*, which build carton tents over the colonies, thus affording them protection against contact insecticides. An account is given of an investigation carried out at Tafo between 1950 and 1953 of the possibility of controlling mealybugs, and thus the spread of the virus, by the systemic insecticides, dimefox (bis(dimethylamino) fluorophosphine oxide) and schradan, and by paraoxon and parathion, which are not strictly systemic in action.

Since the ants removed dead mealybugs from the tents, the effects of treatment could not be assessed from the numbers of living and dead mealybugs in the colonies. Accordingly, in experiments in which few trees were used, samples of colonies were taken at random from each, before and at intervals after treatment, and the tents were opened and the contents counted. In large-scale treatments, involving 250–500 trees, the area was divided into sub-plots each containing 50 trees, of which five were cut down before and five after treatment and all mealybugs on them counted. In

both cases, the results were assessed by expressing the size of the population after treatment as a percentage of that before treatment.

The effects of all the insecticides applied as sprays to the trees at concentrations of up to 1 per cent. were unsatisfactory or inconsistent. In tests of their value when poured into a slight depression made in the soil immediately round the base of the trunk and subsequently filled in, schradan at 0·5 gm. and paraoxon and parathion at 1 gm. in 100 cc. per plant had no pronounced effect when applied to seedlings ten months old growing singly in pots and artificially infested. Dimefox gave very effective initial kills at doses as low as 0·01 gm. per plant and concentrations of 0·1–20 per cent., while doses of 0·4 gm. rendered year-old plants toxic for up to six weeks. When the four insecticides were applied at 40 gm. in 4 litres solution per tree to trees of average size in the field, dimefox again showed marked superiority, and efforts were accordingly concentrated on developing methods for its use in the field.

In order to relate effective dose to tree size, the rates of application were expressed as gm. per inch of girth measured one foot above the ground. In tests of dimefox applied to the soil at rates of 0·4–1·4 gm. per inch of girth, the higher rates gave substantial reductions, but they were nevertheless insufficient and inconsistent. In a further experiment with 500 trees 3–20 ins. in girth, the total mealybug populations on ten groups of sample trees examined six weeks after treatment were 0–4·5 per cent. of those on similar groups before treatment; most of the survivors were on trees 12·5–20 ins. in girth. By applying a range of doses to further samples of heavily infested trees in different girth-groups, the doses required for effective control were shown to be 8, 20, 39 and 70 gm. for girths of 5, 10, 15 and 20 ins., respectively. Since it was desired to relate dosage to the weight of the tree, further investigations were made on trees with girths of 5–30 ins.; these showed that the weight of the aerial part could be related to girth by a formula, which is given.

The effectiveness of the doses prescribed by this girth–weight correlation and applied as solutions containing 5 per cent. dimefox was tested on a further 500 trees 3·5–18·5 ins. in girth. On the 50 examined before treatment, numbers of mealybugs ranged from three to 5,200 per tree and totalled 42,971, while of the 50 examined six weeks after treatment, 33 were uninfested and 35 mealybugs were found on the rest, on which numbers ranged from 1 to 7. Similar counts at the beginning and end of the six-week period on samples of five trees from a similar but untreated plot yielded 3,017 and 5,969 mealybugs, respectively. When the original treatment was repeated at different intervals on different plots, two further applications at eight-week intervals kept the population at a level of 0·6 per cent. of that originally found for about six months, which was thought at the time to be the maximum period for latent virus infection. On trees that received only the original treatment, populations built up rather slowly and 18 weeks later had reached less than 10 per cent. of the original population. Subsidiary experiments, also with doses based on the girth–weight correlation, showed that trees remained effectively toxic for about seven weeks, less than 10 per cent. of the mealybugs with which they were artificially infested becoming established. The effectiveness of dimefox applied to the soil was only slightly affected by heavy rain and not at all by defoliation; no detrimental effect on pollinating insects was observed, and the cacao beans showed no detectable residues. The water in a stream flowing through a 13-acre plot of cacao trees treated nine times at the prescribed doses at eight-week intervals showed an average concentration of 0·22 part dimefox per million over the whole period just below the experimental site. The insecticide was best applied to a depression in the soil made immediately

around the base of the tree, but was as effective when similarly applied in sealed capsules that disintegrated in the soil. Either method is simple and neither involves the use of heavy machinery, which is unsuitable for conditions in the Gold Coast.

In preliminary tests to ascertain whether smaller quantities of insecticides would be adequate if introduced into a hole drilled into the trunk, only dimefox gave encouraging results. Further experiments with this method, referred to as trunk implantation, showed that dimefox was translocated upwards only and that the greatest reduction in populations occurred on those branches directly above the hole. A more even distribution was obtained with four holes per tree, or five for trees 25 ins. or more in girth, each 5/16 in. in diameter and 3·5 ins. deep, drilled at soil level. Mealybug populations remained reduced to 0·5 per cent. or less of their size before treatment for five weeks after the introduction of doses only one tenth of those prescribed by the girth–weight correlation for soil treatment. It appeared, however, that implantation doses calculated by reference to soil treatment were excessive for small trees and inadequate for large ones, and more satisfactory results were obtained by calculating them as a fixed fraction of the weight of the tree, a rate of 160–250 p.p.m. being the most satisfactory.

Distribution Maps of Insect Pests.—Series A, nos. 55–60. London, Commonw. Inst. Ent., 1955.

These maps are nos. 55–60 of a series already noticed [*R.A.E.*, A **40** 203; **43** 262] and deal, respectively, with *Artona catoxantha* (Hmps.), *Phytobia cepae* (Her.), *Mayetiola destructor* (Say), *Pseudaulacaspis pentagona* (Targ.), *Pulvinaria psidii* Mask. and *Lymantria monacha* (L.).

Smirnoff (W.). **Les *Cybocephalus* (Col. Cybocephalidae) d'Afrique du Nord, prédateurs de *Parlatoria blanchardi* Targ. (Homoptera, Coccoidea) parasite du palmier-dattier.**—*Rev. Path. vég.* **33** fasc. 2 pp. 84–101, 13 figs., 1 map, 19 refs. Paris, 1954.

Nitidulids of the genus *Cybocephalus* are useful predators of *Parlatoria blanchardii* (Targ.) on date palms in northern Africa. Observations over four years in Morocco, Algeria and Tunisia showed that the most important were *C. palmarum* Peyer., *C. dactylicus* Peyer., and *C. flaviceps* Rttr. These were present in all three countries, also attacked other Coccids, lists of which are given, and were accompanied in Algeria by *C. syriacus* Rttr. and *C. politus* (Gylh.), which were taken in very small numbers in 1951 and 1954. Other species of the genus observed during the work comprised *C. hispanicus* Rttr., which was predacious on *Lepidosaphes beckii* (Newm.) and *Chrysomphalus dictyospermi* (Morg.) in north-western Morocco, and *C. rabaticus*, sp.n., which was present in all three countries and was predacious on Diaspines on *Citrus*, rosaceous trees, *Acacia* and olive. A key to these and other species of *Cybocephalus* based on the male genitalia is appended, a method of preparing the genitalia for examination is described, and it is stated that a full description of *C. rabaticus* is to be published.

C. palmarum has frequently been misidentified as *C. seminulum* Baudi [*cf. R.A.E.*, A **13** 459; **14** 457; **18** 84; **22** 710], which was described from the Mediterranean and is not predacious on *P. blanchardii*. It was found only in the oases, whereas *C. dactylicus* and *C. flaviceps* were adapted to both maritime and desert conditions, though the former was taken on the coast only in southern Tunisia. The distribution of these three species is shown on a map, and the adults are briefly described. When all three were present

together, *C. palmarum* usually formed about 50–60 per cent. of the *Cybocephalus* population, the two other species being about equally numerous, but it sometimes constituted up to 90 per cent. of it. In the absence of *C. palmarum*, *C. flaviceps* was about three times as numerous as *C. dactylicus*, but the latter was the only species present in one hot dry area in Morocco. The density of the population was estimated by shaking fronds and collecting the insects on sheets, and it was estimated from the results that the numbers of adults of *C. palmarum* on a palm moderately infested by *P. blanchardii* averaged 7,000–8,000. Distribution was irregular, 50·9 per cent. of all the *Cybocephalus* adults collected being taken in oases on the high plateaux of the northern Sahara, 27·3 per cent. in oases in the sandy Sahara and 13·5 in the Saharan plain. In these areas, in all of which *C. palmarum* predominated, *Cybocephalus* spp. formed 85·7, 92·7 and 61·6 per cent., respectively, of all the predators present. They were more numerous on young fronds freshly infested by the scale than on old, thickly encrusted ones. Both larvae and adults were predacious, and all stages of *P. blanchardii* were attacked. One adult was observed to devour up to 11 examples of *P. blanchardii* in 24 hours, but the total numbers killed in the field are much greater, since many scales are attacked, but not eaten, and die as a result of desiccation. Feeding was greater after oviposition than before it and was reduced in winter, though it did not cease.

The adults of *C. palmarum* usually lived for about a month in spring and three weeks in summer, and they survived for 10–12 days without food in the laboratory at 22–24°C. [71·6–75·2°F.]. The eggs were laid on the palms, and the larvae hatched in 4–6 days and fed at first on the crawlers and newly fixed nymphs and later on the nymphs and adults. They pupated either among the fibres or in the ground, the prepupal and pupal stages together lasting 9–11 days in summer and 20–25 days in spring and autumn. A complete generation developed in 20–27 days in May at 20–30°C. [68–86°F.] and a relative humidity of 20 per cent., and seven successive generations were observed at one place in Morocco during 1951.

Owing to their small size, individuals of *Cybocephalus* spp. are easily carried by wind, irrigation water and agricultural implements, and colonies quickly become established in areas only recently infested by *P. blanchardii*. The population increases rapidly at first, but is later limited by destruction of the pupae in the soil by various predators. The larvae are destroyed by the larvae of *Chrysopa vulgaris* Schneider, which are also predacious on *P. blanchardii* [**42** 117], and the adults are eaten by birds. In the spring of 1954, large numbers of predators of *P. blanchardii* were collected in Algeria and despatched by air to Morocco; mortality was only about 10 per cent. among the species of *Cybocephalus* sent, though it was much higher for Coccinellids of the genera *Pharoscymnus* and *Scymnus*.

GIUNCHI (P.). **Contributi alla conoscenza dell'entomofauna dell'erba medica. I. (Nota preventiva.)** [Contributions to Knowledge of the Insect Fauna of Lucerne. I. (Preliminary Note.)]—*Boll. Ist. Ent. Bologna* **19** (1952–53) pp. 1–30, 13 figs., 25 refs. Bologna [1954].

In this paper, which is the first of a proposed series on the insect fauna of lucerne, the author gives systematic lists of the species recorded in the literature as feeding on lucerne in Italy and over 60 observed in Emilia in 1949–50, with notes on the frequency of most of the latter and on the type of injury caused. *Apion pisi* (F.), which has become increasingly injurious in recent years, is dealt with in greater detail. The adults of this weevil appeared on lucerne in the second half of March and paired after a few days. Oviposition began in the first ten days of April, and the eggs were inserted

singly into the leaf buds, or occasionally into the stalks, up to eight being found in one bud. Development on other leguminous plants has been recorded [*cf. R.A.E.*, A **22** 4], but the females were not observed to oviposit on plants other than lucerne and did not do so on *Lathyrus sativus* in the laboratory. The larvae hatched in 6–7 days, fed inside the buds for about 20 days and pupated in the cells thus formed. The pupal stage lasted 10–15 days, and adult emergence began in the first ten days of May. The crop is cut about this time, and the adults, which were numerous, subsequently attacked the young growth, causing considerable damage. They were also common on the leaves of clover and other leguminous fodder crops, but left the plants from the beginning of June and sheltered from the heat beneath weeds and shrubs. Some died in the autumn, but most returned to lucerne in mid-September, where pairing and oviposition took place, the latter continuing until as late as the end of October. The eggs were laid in the buds and to an equal extent in the stalks, which remain in the field throughout the winter. In the laboratory, the females laid about 30 eggs each. The larvae were mostly full-fed by November and overwintered in their cells in the plant or in the soil. Pupation occurred at the beginning of the following March, and the adults emerged after 12–15 days.

Masi (L.). **Descrizione di una nuova specie di** *Derostenus* **Westw. (Hymenoptera Chalcidoidea).** *Derostenus appendigaster* **sp. n.** [Description of a new Species of *Derostenus*, *D. appendigaster*, sp. n.] —*Boll. Ist. Ent. Bologna* **19** (1952–53) pp. 145–146. Bologna [1954].

The Eulophid, *Derostenus appendigaster*, sp.n., is described from adult females taken near Bologna. It is a parasite of the larvae of *Phytomyza atricornis* Mg.

Principi (M. M.). **Sviluppo postembrionale ed etologia della** *Lithocolletis platani* **Stgr. (Lepidoptera Gracilariidae).** [The post-embryonic Development and Bionomics of *L. platani*.]—*Boll. Ist. Ent. Bologna* **19** (1952–53) pp. 171–250, 34 figs., 64 refs. Bologna [1954].

Ferrière (C.). **Les parasites de** *Lithocolletis platani* **en Italie.**—*T.c.* pp. 395–404, 4 figs.

In the first of these papers, detailed descriptions are given of all stages of *Lithocolletis platani* Stgr., which was observed in very large numbers on plane trees (*Platanus occidentalis*) on the Italian coast near Lucca in 1951–52, together with a detailed account of observations on its bionomics and natural enemies. The adults survived for about 25 days in cages when honey or sugar solution was provided, and in July and August pairing began about 24 hours after emergence. There was a preoviposition period of at least eight days in the laboratory, which was sometimes shortened to not more than 5–6 days in the field, and the females laid 2–5 eggs daily, depositing them singly, mostly on the lower surfaces of the leaves. The larvae hatched in 5–11 days and mined the leaves, feeding on the sap during the first four instars, which together lasted for at least nine days in April–May, ten in June, 16 in August and 23–24 in September–October, and on the tissues for the last two, which required at least ten days in May, six in June, 5–6 in August and 33–34 in October–November. They pupated in silken cocoons in the mines, and the first adults emerged 8–10 days later. Pupae of the last generation overwintered in the mines in the fallen leaves, giving rise to adults in the following spring. Four generations were reared

in the year, the adults emerging at the beginning of April and from 23rd May, 4th July and 20th August, respectively. Overlapping occurred in the field, and it is thought that there may be a partial fifth generation in the year. The considerable variations in the duration of the larval stage in different generations are thought to be due to differences in relative humidity, to which the larvae are particularly sensitive. The formation of the mines and the reaction of the leaf cells to attack are discussed.

The natural enemies observed comprised *Chrysopa carnea* Steph., the larvae of which preyed on the larvae of *L. platani* in their mines, and six Eulophids that parasitised the larvae. The latter were submitted for identification to C. Ferrière, who gives descriptions of the adults of all of them in the second paper, together with comments on the taxonomic relations of some. They comprised *Cirrospilus unifasciatus* (Först.), *C. pulcher* Masi, *Plesiospilus* (gen.n.) *unistriatus* (Först.), *Sympiesis sericeicornis* (Nees), *Tetrastichus* (*Tetrastichodes*) *platanellus* (Merc.) [*cf. R.A.E.*, A **11** 204; **13** 212], and a species of the genus *Pediobius* (with which *Pleurotropis*" is shown to be congeneric) described as *P. grandii*, sp.n.

Information on the bionomics of three of the parasites is included in the first paper. Only two females of *S. sericeicornis* were obtained in 1951, but several adults of each sex emerged from material collected in June 1952. The females survived for up to 50 days in the laboratory in summer when drops of honey and water were provided. The eggs, which hatched in about 24 hours, were inserted into mines containing fifth- or sixth-instar larvae or pupae, on which the parasite larvae fed externally. Pupation took place in the mines, and development from egg to adult required not more than 15 days, at least for the males. Small numbers of *P. grandii* emerged from pupae of *L. platani* collected in July–September 1951 and May–June 1952, males and females being present in about equal numbers and surviving for over a month and for about 25 days, respectively, when provided with honey and water. Only one parasite emerged from each host. Pairing was not observed, but only those females that had been confined with males oviposited. Larvae in at least the last three instars were parasitised. They pupated normally, but full-fed parasite larvae were found when the pupae were opened after 7–9 days. The pupal stage of the parasite lasted 9–13 days. The percentage parasitism by *T. platanellus*, though low in June, was considerable towards the end of August, and mines that did not contain the parasite were then uncommon. Males were extremely rare at all times. Females that emerged in August lived for over 30 days and those that emerged in September survived for some months when drops of honey and water were provided. Oviposition began 4–5 days after emergence, and the eggs were inserted into the mines, sometimes in small groups, and hatched in about 48 hours. The newly hatched larvae sought the larvae or pupae of *L. platani*, which they paralysed, fed on them externally and pupated in the mines, the larval, prepupal and pupal stages lasting 6–7, 1–2 and 7–8 days, respectively. *T. platanellus* was occasionally found parasitising the pupae of *S. sericeicornis*.

Teplyakova (M. Ya.). **Pathological Changes in the Ovaries of** *Eurygaster integriceps* **produced by the Action of the Preparation DDT during the active Period of Life.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **101** no. 4 pp. 775–778, 1 pl., 1 fig., 18 refs. Moscow, 1955.

The author describes the ovaries of normal females of *Eurygaster integriceps* Put. and records observations on those of examples collected in wheat fields in Krasnodar in 1950–53 after DDT dusts had been applied in spring at rates of 18 or 36 lb. per acre [*cf. R.A.E.*, A **42** 70–71]. The

bugs were collected daily for ten days after treatment, and thereafter at five-day intervals for as long as survivors were present, and dissected in the laboratory. The results showed that the ovarioles of one and the same individual were affected to different degrees by the DDT, their condition ranging from almost normal to complete atrophy, though the latter was not observed in the better nourished examples. This unevenness in effect probably resulted from injury to the nerves in the tissues connecting the nutritive cells with the ovarioles. The rapidity with which DDT penetrated depended on the physiological condition and state of nourishment of the bugs, and it was found that susceptibility to the poison was sometimes succeeded by resistance to it if the physiological condition had meanwhile changed, provided that irreversible injury had not taken place. This would account for the great diversity in degree of injury observed in different organs of the same bug and even in the same organ.

The extent of the injury caused by DDT depended on the duration of the toxic effect, and it was found that the reactions of the nervous system affected the pathological processes in the ovaries, which passed through two phases. In the first of these, when only a small amount of DDT had penetrated to the tissues, increased stimulation of the cells induced evacuation of prematurely developed eggs into the oviduct, which would explain the increased fecundity of the bugs sometimes observed after dusting with DDT. More often, however, oviposition ceased altogether and the eggs accumulated in the lower section of the ovariole or burst this and fell into the body cavity. This phase lasted for up to 3–4 days, and was followed by the second, in which the nervous system and trophic connections of the ovaries were severely affected and general degeneration set in. The ovarioles underwent three successive stages of destruction, the outer symptoms of which are described. The process did not always begin at the same point, and its progress was irregular, so that different sections of the ovarioles were affected to different degrees. The final result depended chiefly on the extent to which the germarium was affected.

It is concluded that the toxic action of DDT is slow but general and that its effects on the ovaries are severe. The changes in the appearance of the ovarioles are an indication of the internal condition, which is of practical interest for the evaluation of the effect of DDT on fecundity. The injury caused in the first 2–3 days is insignificant and apparently reversible, but irreversible destruction occurs often within 3–5 days, and complete atrophy of the ovarioles follows after a further 6–8 days.

Shumakov (E. M.) & Yakhimovich (L. A.). **Morphological and histological Peculiarities of the Metamorphosis of the Cotton Bollworm** (*Chloridea obsoleta* **F.) in Connection with the Phenomenon of Diapause.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **101** no. 4 pp. 779–782, 2 figs., 6 refs. Moscow, 1955.

The pupal diapause in *Heliothis armigera* (Hb.) (*Chloridea obsoleta* (F.)) is facultative, the frequency of its occurrence depending on the time of year and developmental conditions, and the determination of external characters distinguishing individuals in diapause is very desirable. Observations were therefore carried out in the Soviet Union in which larvae were allowed to pupate in soil in the laboratory at 22°C. [71·6°F.], and the process was studied. The period from the time of entering the soil to the emergence of the adults was 24 days, the first five days being spent in the prepupal stage. The characters of the fat-body in the larvae, at the beginning of the prepupal stage and during the pupal stage, while histolysis and histogenesis are in progress, are described.

Changes in the structure of the head were found to be of particular importance, and attention was drawn to the characteristic pigmented spots on either side in the postgenal region. These represent the larval eyes in process of reduction, and their number and arrangement are specific. In *H. armigera*, there are four spots situated in a row in the middle of the postgenal region. The one nearest to the ventral side is the largest, and it is slightly removed from the other three, which are situated at even distances from one another. On the third or fourth day of pupal development at 22°C., these spots disappear, their outlines first becoming blurred, and they are replaced by the slight brownish coloration characteristic of the compound eyes of the adult in process of formation. The diapause occurs at an early stage of pupal development, before the spots disappear, and the absence of the spots is therefore a sign that development is proceeding. When the pupae were kept at 22°C. or above, diapause and non-diapause pupae could be differentiated by this means on the fourth day.

It is further shown that the period of transformation is divisible into four phases, the prepupal stage, the phase of early pupal development, terminating with the disappearance of the spots, a middle phase, and a final phase during which the adult is formed and emerges. The effects of histolysis on the internal structure of the pupa during the first two phases and of histogenesis during the last two are described. At 22°C., the early phase of development of non-diapause pupae lasted four days, the middle phase eight days, and the final phase seven days, the pupae darkening in colour 1–2 days before adult emergence.

Kozhanchikov (I. V.). **Peculiarities of the Hibernation and Cold-hardiness of *Laphygma exigua* Hb. (Lepidoptera, Insecta).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **103** no. 3 pp. 517–519, 21 refs. Moscow, 1955.

Laphygma exigua (Hb.) develops uninterruptedly at all times of the year under tropical and subtropical conditions but hibernates in temperate regions, though there is no true diapause. It has been recorded as hibernating in the adult stage and in the egg and pupal stages, and investigations in Soviet Central Asia have shown that hibernation of the larvae is possible. All authors have observed high mortality during hibernation, however, and investigations were carried out to determine whether this was due to insufficient cold-hardiness.

The eggs easily survived exposure to temperatures between −19 and −20°C. [−2·2 and −4°F.] for ten minutes. All those that were cooled for ten minutes at −18°C. [−0·4°F.] hatched on being transferred to 25°C. [77°F.], and mortality reached 40 per cent. only after exposure to −20°C. At the same time, eggs kept under hibernation conditions at about 0°C. [32°F.] or lower for 2–3 days developed until embryogenesis was complete, after which some or occasionally all of them died. There was very little survival after six days in the hibernation conditions, and none after eight.

The larvae showed maximum cold-hardiness during the first half of their growth, but did not survive the complete cessation of development caused by low temperatures. With the exception of very large larvae in the fourth and fifth instars, which survived for a week, all died in 3–4 days at temperatures between 2 and −2°C. [35·6–28·4°F.]. Newly hatched larvae that had not fed died under the hibernation conditions in 1–2 days. Cooling for a short time was not detrimental, and individuals in the fourth instar survived partial formation of ice at −4°C. [24·8°F.]. Larvae in the last two instars froze at −7°C. [19·4°F.], however, and on thawing made only convulsive movements and eventually died. At about 14°C. [57·2°F.],

which is close to the threshold of larval development, growth was possible from the first instar, but the larval stages lasted 2½ months. Intermittent cooling to −4°C. for short periods prolonged development to over three months and was accompanied by high mortality.

The pupae were more cold-hardy than the larvae, but less so than the eggs. At 8–10°C. [46·4–50°F.], development was retarded and almost all the pupae died within 3–4 months, though a few survived for up to four months. At 12·5°C. [54·5°F.], development was completed in about 20 days and the resulting adults were fertile, but pupal mortality was 32 per cent. This indicated that the threshold of pupal development is lower than has been supposed [*cf. R.A.E.*, A **24** 739].

The adults were short-lived, but low temperature somewhat prolonged their life. They survived for over a week and continued to oviposit at 10°C., but died in 10–15 days between 10°C. and 0°C. and in a few days or even hours at temperatures below freezing point.

The data obtained showed that *L. exigua* is able to survive the winter only if it is short and if freezing temperatures are interrupted by lengthy warm spells. Hardly any stage would survive frost lasting for 20 or more days. Northern regions with continuous winter frost are therefore unfavourable, but survival is possible in areas with a warm winter even though this may be preceded by prolonged autumn frosts.

Seshagiri Rao (D.). **Notes on Rice Moth,** *Corcyra cephalonica* **(Stainton) (Family: Galleriidae; Lepidoptera).**—*Indian J. Ent.* **16** pt. 2 pp. 95–114, 24 refs. New Delhi, 1954.

Corcyra cephalonica (Stnt.), an important pest of stored products in India, is used there as a laboratory host for the mass-production of *Trichogramma minutum* Ril., which is released against *Chilotraea infuscatella* (Sn.) (*Argyria sticticraspis* Hmps.) on sugar-cane. The author reviews its synonymy, distribution and range of food materials from the literature. In rearing experiments, it fed on cereals, pulses, oil-cakes, nuts (mostly broken), dried fruits and various processed foods, but the development period was shortest, the percentage emergence greatest and the adults largest when it was reared on cereals. Fecundity and the length of adult life varied considerably. Males and females lived for averages of 4·9 and 7·2 days, and large moths laid more eggs than smaller ones, the average numbers being 139 and 93 per female; all still contained eggs at the time of death, and the presence of food for the larvae was not essential for oviposition.

Larvae subjected to frequent removal from their silk cases appeared to mature more rapidly than those left undisturbed, the development period lasting 47–57 instead of 48–60 days. Males passed through 6–7 instars, whereas most females had eight, which probably accounted for their greater size. Observations carried out each month from July 1951 to June 1952 showed that development was more rapid but larval mortality higher during periods of high temperature and low relative humidity, and development slower but the rate of emergence higher when the temperature was low and humidity high, as in the monsoon and winter months. During their development, single larvae consumed nearly 0·14–0·5 gm. sorghum and produced 0·0162–0·165 gm. frass and dust, the weight of food taken being inversely proportional to the period of growth. Withholding food from growing larvae at regular intervals showed that fasting on alternate days retarded development and caused a high rate of mortality, whereas starvation on every third day had apparently no ill effect and fasting from 5 p.m. to 11 a.m. and feeding the rest of the time each day seemed to accelerate development. When wholemeal wheat flour was treated with chloroform

or benzene to extract the soluble components, and then dried and supplied to *Corcyra* larvae, these did not develop; when it was similarly treated with rectified spirits, carbon tetrachloride or acetone, the period of development was prolonged and the rate of adult emergence reduced, and it is concluded that the first two solvents removed growth-promoting substances completely. Removing all the free water by heating prevented larval development in wheat flour but did not affect it in broken sorghum.

PRADHAN (S.) & GOVINDAN (M.). **Effect of Temperature on the Degree of Susceptibility of Insects to Fumigation.**—*Indian J. Ent.* **15** (1953) pt. 4 pp. 362–375; **16** pt. 2 pp. 115–136, 20 figs., 33 refs. New Delhi, 1954.

In the experiments described, laboratory-reared adults of *Tribolium castaneum* (Hbst.), 6–8 weeks old, were fumigated in flasks with carbon bisulphide at 15 mg. per litre in eight tests and with ethylene dichloride at 40 mg. per litre in two. The exposure period was 24 hours in all but one test, and the relative humidity was maintained at 43–48 per cent. Before, during and after fumigation, the insects were subjected to constant temperatures within the ranges 13–18, 22–28 and 29–35°C. [55·4–64·4, 71·6–82·4 and 84·2–95°F.], referred to as low, medium and high, respectively. After fumigation, the insects were kept without food in open petri dishes and mortality counts were made daily for 7–10 days.

The effect of pre-fumigation temperature was tested with six combinations of fumigation and post-fumigation temperatures, that of fumigation temperature with 16 combinations of pre- and post-fumigation temperatures and that of post-fumigation temperature with 22 of pre-fumigation and fumigation temperatures. With a medium fumigation temperature, varying the pre-fumigation temperature caused an increase in kill with rise in temperature when the post-fumigation temperature was high or low but had no definite effect when it was intermediate. When the fumigation temperature was varied, kill rose with temperature throughout the period of observation in 12 tests, but was highest at the medium temperature in two and lowest at it in three; in the remaining tests, kills were proportional to temperature at some intervals after treatment and highest or lowest at the medium temperature at others. Varying the post-fumigation temperature resulted in kills proportional to temperature in five instances, inversely proportional to it in one, lowest at the medium temperature in 12 and differing in relation to temperature at different periods after treatment in seven; the results were not clear in four tests. Reducing the period of exposure to carbon bisulphide from 24 to five hours resulted in mortalities too low to be assessed at any but the high fumigation temperature combined with the low post-fumigation temperature.

The results of these and similar tests recorded in the literature are analysed, the explanations offered by earlier workers are discussed, and it is concluded that the effect of temperature depends on several factors and is different at different intervals after treatment, which may account for inconsistencies in the earlier results.

PUTTARUDRIAH (M.) & KRISHNAMURTI (B.). **Problem of *Epilachna* Control in Mysore: Insecticidal Control found inadvisable when natural Incidence of Parasites is high.**—*Indian J. Ent.* **16** pt. 2 pp. 137–141, 2 refs. New Delhi, 1954.

Epilachna vigintioctopunctata (F.), a serious pest of potato, tomato, brinjal [*Solanum melongena*] and cucurbits in Mysore, has been commercially controlled by repeated spraying with calcium arsenate, lead

arsenate or DDT or dusting with DDT, BHC or toxaphene. In untreated areas, the larvae are parasitised by *Pediobius* (*Pleurotropis*) *foveolatus* (Crwf.), the percentage parasitism sometimes reaching 70–74 in February and March and 68 in July. Parasite numbers increase greatly in the summer months, provided that the host population is high and there is no continuous heavy rainfall. Experiments showed that heavy infestations of *Epilachna* destroyed potato plants rapidly in the absence of the parasite but caused little damage if it was present.

To determine whether insecticides had a deterrent effect on the parasite and whether their use might safely be reduced, parasitised fourth-instar larvae of *Epilachna* were sprayed with calcium arsenate, lime, jaggery and water (1:2:3:50) or 1 lb. 50 per cent. wettable DDT in 16 gals. water or dusted with 5 per cent. DDT or BHC or 20 per cent. toxaphene and kept in petri dishes. Parasites emerged and survived for varying periods, depending on the amount of insecticide on the host larvae; they died almost immediately when the larvae had been dusted with BHC, but were unaffected by calcium arsenate and attacked fresh hosts after removal from the dishes. When healthy fourth-instar larvae of *Epilachna* were treated with the same insecticides and exposed to adult parasites for oviposition, the latter died within a few hours without ovipositing when the larvae had been treated with the dusts or the DDT spray but oviposited in those sprayed with calcium arsenate. In the last case, adult parasites emerged, behaved normally and attacked fresh hosts, and it is concluded that the calcium-arsenate spray is the least harmful of the treatments tested.

In field observations, plots of infested potato and brinjal, in which the natural incidence of the parasite was about 60 per cent., were treated with the insecticides in February 1954 and larvae of *Epilachna* collected two days later. Parasites emerged from them after four days, those from untreated larvae and larvae sprayed with calcium arsenate living longer than those from the other plots, which died within a day.

It is concluded that insecticidal treatment against *Epilachna* is generally unnecessary during the summer but desirable at other times of the year. The need for it can be ascertained by collecting batches of larvae and determining the percentage parasitism.

Gupta (R. L.) & Rawat (R. R.). **Life-history of** *Hypolixus truncatulus* **(Boh.)** (= *Lixus brachyrhinus* **Boh.)—the Rajgira Weevil.**—*Indian J. Ent.* **16** pt. 2 pp. 142–144, 5 refs. New Delhi, 1954.

Hypolixus truncatulus (F.) is a major pest of cultivated *Amarantus*, particularly rajgira [*A. paniculatus*], throughout India. The adults feed on the tender leaves and stems, but do little damage, whereas the larvae tunnel the stems, 17–18 sometimes being present in a single plant, and cause them to rupture or break off. The weevil was fairly numerous in 1946–47 on rajgira in Madhya Pradesh. Observations on its life-history there showed that the female deposits about 30 eggs singly in holes made in the stems. The larva hatches in 2–4 days, tunnels downwards in the stem, consuming most of the pith, and becomes full-fed in 20–24 days in October–November and in 12 days in May. Pupation occurs in a cell just below the epidermis at the soil surface or at the axil of a branch. The adult emerges after about ten days in summer and 14–18 days in October–December and bites its way out of the stem about 5–6 days later, causing further weakening. Breeding occurred throughout the season, though activity was much less during winter, and the adults survived for 12–66 days.

KEVAN (D. K. McE.). **A Study of the Genus *Chrotogonus* Audinet-Serville, 1839 (Orthoptera: Acrididae). III. A Review of available Information on its economic Importance, Biology, etc.**—*Indian J. Ent.* **16** pt. 2 pp. 145–172, 89 refs. New Delhi, 1954.

Acridids of the genus *Chrotogonus* are known to be destructive to crops in the Indian region and in tropical Africa, but their pest status is difficult to determine and their taxonomy confused. The author gives a critical review of published and other records of damage by them in India and Pakistan and in various African territories, and reviews the literature on their importance, bionomics and control, with notes on the identity of the species concerned.

It is concluded that members of the genus attack plants of many families, including woody plants and cereals. *C. homalodemus* (Blanch.) in the Sudan is sometimes apparently reluctant to feed on graminaceous plants and seems not to be a serious pest of crops. Other species, however, cause severe losses, both in the Indian subcontinent and in Africa, and some damage has been recorded from the intervening region. Injury is severe only on very young plants, which are bitten off as soon as they appear above ground or shortly after, and early in the season, especially when crops are sown in anticipation of rain, since these supply almost the only food available. Damage is apparently more severe in seasons of deficient rainfall, and outbreaks are sporadic and local in occurrence.

The species of importance in the Indian subcontinent are *C. trachypterus* (Blanch.) in West Pakistan and north-western India, and *C. oxypterus* (Blanch.) in southern India. The crops most affected appear to be millets (sorghum, *Eleusine coracana* and *Pennisetum typhoides*), sesame (*Sesamum orientale* (*indicum*)), tobacco, indigo, cotton and the seedlings of certain trees, especially *Pinus longifolia*. *C. homalodemus* attacks crop plants from south-western Persia to parts of the Sudan, but apparently less seriously. In East and central Africa, *C. hemipterus* Schaum is of some importance on vegetables, groundnuts, castor (*Ricinus communis*) and particularly tobacco seedlings; *C. senegalensis abyssinicus* Bol. causes considerable seasonal damage to *E. coracana* in Uganda [*R.A.E.*, A **28** 308], and a subspecies of *C. homalodemus* occasionally injures similar crops in Somalia. Two subspecies of *C. senegalensis* Krauss sometimes injure *P. typhoides* in West Africa, but a species probably belonging to the group of *C. homalodemus* is responsible for the damage in the north of the Niger Colony of French West Africa.

The economic importance of the genus is variable, being apparently governed by seasonal and climatic factors, and is difficult to assess. Even primitive methods of cultivation appear to favour the Acridids, and they are not unlikely to increase in importance in Africa with the development of scientific agriculture. BHC baits are said to give cheaper and more effective control than spraying or dusting. Persistent deposits of such insecticides as dieldrin on seedlings and various cultural measures would probably be effective.

The Acridids occur mainly on bare soil, particularly near water; some may be found under arid conditions, but these are favoured by few species. Some species are found among short grass, such as *Cynodon*, but taller vegetation provides entirely unsuitable conditions; though usually considered to belong to the lowlands, *Chrotogonus* spp. occur at altitudes of over 8,000 ft. in parts of south-western Arabia and the Indo-Iranian region. In most species, adults and nymphs are present together for most of the year. The number of generations appears to be indefinite, and probably depends on climate, especially rainfall; *C. hemipterus* appears to decline markedly in

numbers after the beginning of the rains. Activity is influenced by climatic conditions, but the tropical and sub-tropical species appear to remain active throughout the year, in some cases sheltering in cracks in the soil during drought, but not undergoing any form of aestivation. No true diapause is recorded for any stage of any species, but *C. turanicus* Kuthy is said to hibernate as a nymph or adult in Soviet Central Asia and may have only one generation a year. In Pakistan, *C. trachypterus* overwinters in any stage and is reported to have two generations a year.

Oviposition has been observed mainly in bare soil or sand. Females of *C. trachypterus* deposit several egg-pods, usually containing less than 40 eggs each, in a hole about an inch deep; the period of development varies with the temperature and may be prolonged. *C. oxypterus* appears to have a similar life-history. Several species that are normally flightless have small numbers of fully alate forms, capable of short flight; in some species either the females only or both sexes are commonly flightless, whereas in others both sexes are apparently always alate.

Little is known of the natural enemies of these Acridids. Parasitic mites seem rarely to attack them, Hymenopterous and Dipterous predators have been observed in Nyasaland, and fowls and wild birds will apparently feed on them, their sluggishness rendering them easy to catch.

Pradhan (S.) & Govindan (M.). **Bioassay of Insecticides—III. Comparative Toxicity of six common Fumigants to** *Trogoderma granaria* **Everts (Grubs) and** *Tribolium castaneum* **Herbst (Adults).**—*Indian J. Ent.* **16** pt. 2 pp. 173–175, 4 refs. New Delhi, 1954.

In this third part of a series [*cf. R.A.E.*, A **42** 260; **43** 186], an account is given of tests in which hydrogen cyanide, methyl bromide, carbon bisulphide, ethylene dichloride, carbon tetrachloride and a mixture of the last two (3:1 by volume) were compared against fourth-instar larvae of *Trogoderma granarium* Everts and adults of *Tribolium castaneum* (Hbst.) 8–10 weeks old. The insects were kept without food at 50–55 per cent. relative humidity for 24 hours before treatment, exposed to the fumigant in flasks for 24 hours and then removed, kept at the same humidity and temperatures of 92–100°F. for *Trogoderma* and 86–92° for *Tribolium* and examined for mortality after 7 and 5 days, respectively. The fumigants were usually tested at ten concentrations, and the median lethal concentrations were calculated from 5–6 effective ones. The results are given in tables and showed that methyl bromide, carbon bisulphide, ethylene dichloride, carbon tetrachloride and the mixture were 90, 26, 9, 3·7 and 9 per cent. as toxic as HCN to *Trogoderma* and 91·3, 9·3, 3·1, 1·9 and 3·5 per cent. as toxic as HCN to *Tribolium*.

Pingale (S. V.), Muthu (M.) & Kapur (N. S.). **The Effect of the Persistence of DDT Residues on stored Potatoes.**—*Indian J. Ent.* **16** pt. 2 pp. 189–195, 2 figs., 14 refs. New Delhi, 1954.

The results are given of experiments in which freshly dug potato tubers were shaken for 30 minutes with 1, 2 or 3 oz. 5 per cent. DDT dust per maund [about 82 lb.], to protect them against *Gnorimoschema operculella* (Zell.), stored in wooden containers freely exposed to light and air at temperatures of 25–28°C. [77–82·4°F.] and 55–70 per cent. relative humidity, and tested for DDT residues after 2, 4 and 6 months. Though there was a progressive reduction in residue, tubers receiving the three doses still bore 22·4, 39 and 56·3 parts DDT per million, respectively, after six

months, as compared with 36·7, 80·2 and 114·5 p.p.m. immediately after treatment. The residue was not completely removed by washing, boiling or both, but no DDT was found in peeled tubers. Potatoes treated at the two higher rates and subsequently washed caused harmful changes in the liver of rats that fed for two months on a diet containing about 18 per cent. of them.

In view of these results and of the practical difficulty of making correct and even dust applications on a large scale, further investigations are considered necessary before the treatment of stored potatoes with DDT is recommended.

Kanakaraj David (S.). *Rhopalosiphoninus latisiphon* (**Davidson**) (**Aphididae**)—**a new Record for India.**—*Indian J. Ent.* **16** pt. 2 p. 196. New Delhi, 1954.

The shoots of potato tubers stored at elevations of 5,000–7,200 ft. in the Nilgiri Hills (Madras) were known, at least since 1946, to be attacked by Aphids. These were identified in 1954 as *Rhopalosiphoninus latysiphon* (Davidson), which was hitherto known only from Europe and North America [*cf. R.A.E.*, A **43** 446, etc.]. It is suggested in a footnote that it was possibly introduced from Europe on imported tubers.

Banerjee (S. N.). **Experiments on the Control of Jute Pests in West Bengal.**—*Indian J. Ent.* **16** pt. 2 pp. 199–202. New Delhi, 1954.

In 1951, it was found that routine dusting with 5 per cent. BHC did not give adequate control of *Anomis sabulifera* (Gn.) and *Diacrisia obliqua* (Wlk.) on jute in West Bengal, and this and other organic insecticides were therefore compared at various rates in 1952–53.

In 1952, 5, 7 and 10 per cent. BHC dusts, containing 0·65, 0·9 and 1·3 per cent. γ isomer, respectively, were applied at 6 oz. per 1,000 sq. ft., and sprays containing 0·5, 1, 1·5 and 2 per cent. 50 per cent. wettable BHC (6·5 per cent. γ isomer) or DDT at 1 gal. per 1,000 sq. ft., when the plants were 44 days old. The two highest concentrations of each formulation gave about 90 per cent. or more mortality of *Anomis* in 24 hours and of *Diacrisia* in 48 hours and were more effective than the lower ones. As rapidity of control is important on such a valuable crop, parathion was tested in 1953. Sprays prepared from a proprietary preparation of unspecified parathion content were applied when the plants were 48 days old and gave complete control of *Anomis*, *Diacrisia* and *Laphygma exigua* (Hb.) in 24 hours at a suitable concentration.

Pritchard (A. E.) & Baker (E. W.). **A Revision of the Spider Mite Family Tetranychidae.**—*Mem. Pacif. Coast ent. Soc.* **2** 9½ × 6¼ ins., [7 +] 472 pp., frontis., 1 col. pl., 391 figs., 14 pp. refs. San Francisco, Cal., 1955. Price $10.

This monograph constitutes the first comprehensive revision of the Tetranychids of the world and collates divergent views that have been held on their classification in the United States and Europe [*cf. R.A.E.*, A **39** 100–102]. They are divided into two subfamilies, the Bryobiinae and the Tetranychinae, and these into three tribes each. Keys are included to the subfamilies, tribes, genera and species (of North America or the world), and information is given on the synonymy, diagnostic characters, distribution

and food-plants of the individual species, some of which are described as new.

In the BRYOBIINAE, *Pseudobryobia* is congeneric with *Bryobia*, and *Tetranobia* and *Tetranychina* with *Petrobia*. In the tribe EURYTETRANYCHINI, *Simplinychus* is congeneric with *Eurytetranychus*. Seven genera are recognised in the tribe TETRANYCHINI, which includes most of the species of economic importance. These, with their type species in brackets, are *Metatetranychus* (*Tetranychus ulmi* Koch), *Allonychus*, gen. n. (*Septanychus braziliensis* McG., the only included species), *Schizotetranychus* (*T. schizopus* Zacher), with which *Peritetranychus* is congeneric, *Neotetranychus* (*N. rubi* Trägårdh), *Eotetranychus* (*Trombidium tiliarium* Herm., referred to in original designation as *Acarus telarius* L.), *Oligonychus* (*Heteronychus brevipodus* Targ.) and *Tetranychus* [of which the type species, *T. lintearicus* Dufour, is not cited as such, but is included in the synonymy of *T.* (*A.*) *telarius* (L.)]. *Tetranychus* and *Oligonychus* are distinguished from the other five genera in that they have an opisthosoma with a single pair of para-anal setae instead of two. *Paratetranychus*, for which *T. ununguis* Jacobi is designated the type, is considered congeneric with *Oligonychus*, which contains all the species that the author cites as having been included in *Paratetranychus* except *T. ulmi* (of which *P. pilosus* (C. & F.), *P. pilosus occidentalis* McG. & Newcomer and *Metatetranychus mali* Oudm. are synonyms) and *T. citri* McG. These two are referred to *Metatetranychus*, of which the only other species recognised are *M.* (*T.*) *spinigerus* (Lucas) and *M. hadzhibejliae* Rekk. It is pointed out that the early use of *T. mytilaspidis* (Ril.) for *M. citri* was due to misidentification; the mite described by Riley [*Penthalodes mytilaspidis*] is not a Tetranychid. *Eotetranychus* comprises over 40 species, including *E. aurantii* (Targ.) (*T. quercinus* Berl.), *E.* (*T.*) *caribbeanae* (McG.), *E.* (*T.*) *fagi* (Zacher), *E.* (*T.*) *carpini* (Oudm.) (*T. flavus* Ewing, *T. oregonensis* McG., *T. monticolus* McG.), *E.* (*T.*) *hicoriae* (McG.), *E.* (*T.*) *lewisi* (McG.), *E.* (*T.*) *multidigituli* (Ewing) (*T. ellipticus* Garman), *E.* (*T.*) *populi* (Koch) (*T. salicicola* Zacher), *E.* (*T.*) *sexmaculatus* (Ril.), *E.* (*T.*) *suginamensis* (Yokoyama) (*T. mori* Rahman & Sapra), *E.* (*T.*) *talisiae* (Hirst), *E.* (*T.*) *weldoni* (Ewing) (*T. californicus* McG.) and *E.* (*T.*) *yumensis* (McG.). *E. hirsti*, n.n., is proposed for *T. fici* Hirst, which is preoccupied by *T. fici* Murray, a synonym of *T. telarius*.

Other changes in specific synonymy that affect names that have been used in this *Review* include *Bryobia praetiosa* Koch (*brevicornis* Ewing), *Petrobia harti* (Ewing) (*Tetranychina macdonoughi* McG.), *P. latens* (Müller) (*P. lapidum* (Hammer), *Tetranychus* (*Paratetranychus*) *longipes* Banks, *Tetranobia decepta* Banks), *Eutetranychus banksi* (McG.) (*Tetranychus rusti* McG., *E. clarki* (McG.), *Anychus verganii* Blanch., *A. ricini* Rahman & Sapra, *A. orientalis* (Zacher) Klein, which appears to be based on a manuscript name of Zacher), *Schizotetranychus asparagi* (Oudm.) (*S. floridensis* (McG.)), *Oligonychus coffeae* (Nietn.) (*Paratetranychus bioculatus* (Wood-Mason)), *O. ununguis* (*Tetranychus uniunguis* Ewing, *Paratetranychus americanus* (Ewing), *P. pini* Hirst), *O. yothersi* (McG.) (*P. major* (Ewing)), *O. punicae* (Hirst) (*P. coiti* McG.), *O. pratensis* (Banks) (*P. simplex* (Banks)), *O. indicus* (Hirst) (*P. mexicanus* McG. & Ortega), *O. biharensis* (Hirst) (*P. hawaiiensis* McG.), *Tetranychus viennensis* Zacher (*crataegi* Hirst, *longipenis* Ugar. & Nik.), *T. ludeni* Zacher (*Septanychus deviatarsus* McG.) and *T. cucurbitae* Rahman & Sapra (*equatorius* McG.). *T. exsiccator* Zhnt. is transferred to *Oligonychus*.

The name *Tetranychus telarius* is retained for the common spinning mite [*cf.* **13** 3], and is believed to denote a polytypic species, represented by at least several subspecies or species. Its synonymy is dealt with at some

length, and *T. russcolus* Koch, *T. fragariae* Oudm., *T. manihotis* Oudm., *T. (Eotetranychus) scabrisetus* (Ugar. & Nik.), *T. (E.) cucurbitacearum* (Taher Sayed), *T. (Acarus) cinnabarinus* (Boisd.), *T. multisetis* McG. and *T. bimaculatus* Harvey (two-spotted mite) are among the many names referred to it. Some of the problems in its synonymy arise from the existence of colour forms to which various names have been applied. In the more temperate zones of each hemisphere, the actively feeding females are greenish in colour and typically have a large internal dark trifid spot on each side of the body, but the non-feeding phase is orange and has often been referred to as red (hence the name red-spider). In the tropics, however, and often in northern greenhouses, the females are carmine in basic colour, typically with darker internal markings on each side. Most of the morphological differences in specimens studied by the authors were in forms from the tropics or subtropics, presumably carmine in colour. The form with greenish females is held to be the typical *T. telarius* and *T. telarius cinnabarinus* appears to be the earliest trinomial for the carmine forms, but a carmine form with additional setae on the fore legs was described as *T. multisetis*. In cross-breeding experiments [**40** 240], Davis showed that this character was of no value for differentiating carmine forms from one another, but Keh found evidence of reproductive isolation in the F_1 generation in many of his crosses between the green form and the *multisetis* carmine form, which suggests a subspecific or specific difference between the two colour forms. B. Boudreaux (*in litt.*) has suggested that rearing experiments indicate that the green form (*telarius*) and the red form (*cinnabarinus*) are distinct species, with *multisetis* a subspecies or variety of *cinnabarinus*. Lack of knowledge of the outdoor occurrence of the carmine mites in Europe and their possible confusion with the orange phase of the green form add to the difficulty of the problem.

The new species described include *Aplonobia myops*, which was reported as causing considerable damage to asparagus, *Oligonychus endytus*, which is a serious pest of chestnut and is also recorded on oak, and *Tetranychus hydrangeae*, which is an important pest of hydrangeas and is also recorded from other greenhouse plants and from beans, all in California.

Kirby (A. H. M.), Tew (R. P.) & Gambrill (R. G.). **The Fruit Tree Red Spider Mite, *Metatetranychus ulmi* (Koch): Pilot Trials in the Field of some new Ovicides active against Winter Eggs.**—*41st Rep. E. Malling Res. Sta. 1953* pp. 171–174, 6 refs. East Malling, 1954.

As late applications of 3 per cent. petroleum oil for the control of the winter eggs of *Metatetranychus ulmi* (Koch) have sometimes injured the buds of fruit trees in Britain, tests were made with the winter ovicide dinoseb and with various chlorinated phenyl benzenesulphonates that can safely be applied at the green-cluster stage or later.

In the laboratory, shoots bearing winter eggs were dipped in aqueous solutions of a commercial sample of the triethanolamine salt of dinoseb on 1st March 1950, and observations in the following summer showed that concentrations of 0·225, 0·115 and 0·06 per cent. actual dinoseb gave 100, 100 and 90 per cent. mortality, respectively. Similar treatment of eggs on apple seedlings in a greenhouse on 8th March 1951 with 0·06, 0·03 and 0·015 per cent. dinoseb resulted in 92·5, 44·8 and 25·5 per cent. mortality, indicating a median lethal dosage of about 0·026 per cent.

In the field in 1951, the same salt of dinoseb at 0·5 and 0·75 per cent. (0·113 and 0·17 per cent. actual dinoseb) and at the lower concentration with the addition of a wetting agent (dioctyl sodium sulphosuccinate or a

non-ionic surface-active agent of the ethylene oxide condensate type) and an adhesive of the polyethylene-polysulphide type was compared with a standard spray of DNC and oil and with no treatment. Sprays were applied to apple trees on 21st February, and mite counts on 11th June showed that the lower concentration of dinoseb alone gave no significant control, whereas the lower concentration with either wetting agent gave significant control and was as effective as the higher one alone; the mixture with the surface-active agent did not differ significantly from DNC with oil, which was significantly superior to all other treatments except dinoseb with both sulphosuccinate and polyethylene polysulphide; this resulted in a very substantial improvement in control. None of the treatments injured the trees. In 1952, sprays containing 0·09 per cent. dinoseb in the triethanolamine salt, alone or with 0·05 per cent. polyethylene polysulphide or 0·25 per cent. calcium caseinate, or with each of these and 0·01 per cent. dioctyl sodium sulphosuccinate, were applied to the trees on 10th March. Counts on 27th May showed that dinoseb alone and in each spray with polyethylene polysulphide halved the mite population, as compared with untreated trees, whereas the other treatments did not reduce it. It is concluded that dinoseb is toxic to the winter eggs of *M. ulmi* and gives substantial control if sufficient wetting agent and adhesive are added. It is unlikely to be economical for use in all seasons and seems to offer little advantage over sprays of DNC and oil.

As laboratory tests in 1951–52 showed that certain chlorinated phenyl benzenesulphonates at concentrations of not less than 0·1 per cent. were toxic to both winter and summer eggs of *M. ulmi*, 4-chlorophenyl 4-chlorobenzenesulphonate, 4-chlorophenyl benzenesulphonate and 2,4-dichlorophenyl benzenesulphonate were tested on a small scale on apple in the field [*cf. R.A.E.*, A **40** 238]. They were all applied at concentrations of 0·1 per cent. at the green-cluster stage, and the second at 0·2 per cent. at this stage and at 0·05 per cent. at both the green-cluster and pink-bud stages or both the pink-bud and petal-fall stages. Examination on 4th June showed that all treatments gave very good control, but there was slight spray injury on trees receiving 4-chlorophenyl benzenesulphonate at the highest concentration or at both the pink-bud and petal-fall stages. It is concluded that treatment with any of these compounds at 0·1 per cent. at the green-cluster stage should give excellent mite control until at least early June.

Kirby (A. H. M.) & Gambrill (R. G.). **The Hatching of Summer Eggs of the Fruit Tree Red Spider Mite, *Metatetranychus ulmi* (Koch), under artificial Conditions.**—*41st Rep. E. Malling Res. Sta. 1953* pp. 175–179, 5 graphs, 3 refs. East Malling, 1954.

The effect of temperature, including diurnal variation, and of light on the hatching of summer eggs of *Metatetranychus ulmi* (Koch) was tested in England in 1952–53. Apple leaves bearing large numbers of third- and fourth-generation eggs were collected in July and August, kept under various conditions, and observed for hatching at intervals of 1–3 days. Hatching was satisfactory, reaching 80–90 per cent. in 14 days, when the eggs were kept in the dark at a constant temperature of 24°C. [75·2°F.] or at 24° for eight or 16 hours of every 24 and at 18°C. [64·4°F.] for the remainder, and also when they were kept uncovered in daylight from a north window at laboratory temperatures. Storage in the dark at 18°C. retarded development considerably (50–60 per cent. hatch in 14 days) and storing in the dark at laboratory temperatures retarded it for 4–5 days, this

retardation being maintained in 1953 (about 60 per cent. hatch in 14 days) but not in 1952 (about 80 per cent. hatch in 14 days); the reason for the difference in the two years is not clear.

The results indicate that light was not essential for hatching, at least beyond the diffuse daylight reaching the eggs for the 15 minutes required every 24–72 hours for counting, provided that the temperature was maintained at 24°C. for a third of each day, but that it may be necessary at lower temperatures.

Chaboussou (F.) & Bessard (A.). **La question des tétranyques ou araignées rouges sur les arbres fruitiers.**—*Rev. Zool. agric.* **53** no. 4–6 pp. 49–66, 6 figs., 33 refs. Talence, 1954.

Tetranychid mites are becoming increasingly important on fruit trees in France [*cf. R.A.E.*, A **43** 260–261, etc.], the most important being *Metatetranychus ulmi* (Koch), *Bryobia praetiosa* Koch and *Tetranychus telarius* (L.) (*urticae* Koch), which have 5–6, 4 and 7–10 generations, respectively, in the course of the season, and *T.* (*Amphitetranychus*) *viennensis* Zacher, about which little is known. Notes are given on their bionomics and food-plants, and the influence of insecticidal and fungicidal treatments on mite populations is discussed from observations in south-western France.

During experiments on the control of *Cydia* (*Laspeyresia*) *pomonella* (L.) on apple in the Landes district, sprays were applied on 24th May, 13th June, 3rd and 25th July and 26th August in 1950. Infestation by mites, probably *B. praetiosa*, greatly increased when the trees were sprayed five times with 0·1 per cent. wettable DDT with or without the addition of an unspecified experimental acaricide on the last three dates, and when they received two applications of 0·1 per cent. DDT or 0·084 per cent. lead arsenate followed by three of 0·45 per cent. sodium fluosilicate. Except for DDT with the acaricide, these treatments also resulted in an increase in the number of twigs infested by *Eriosoma lanigerum* (Hsm.), and there was an especially great increase in this Aphid when the trees were sprayed twice with lead arsenate and three times with an emulsion containing 0·033 per cent. DDT and 0·12 per cent. oil. There was no increase in the Aphid and a decrease in the mites when lead arsenate was applied alone five times, and, in one series but not in another, when 0·015 per cent. parathion was included in the last three applications of DDT. In 1952, mite infestation was negligible on trees that received neither summer nor winter treatments but was considerable on those that received summer treatments with 1 per cent. DDT, 5 per cent. white oil and 1·3 per cent. zineb [zinc ethylene bisdithiocarbamate], and was also considerable though somewhat irregular on those that had received in addition a winter spray of 0·045 per cent. parathion and 2·4 per cent. oil. Populations were small following winter sprays of DNC in oil emulsion and summer sprays of lead arsenate. It appeared that zineb in summer sprays somewhat favoured increases in mite population, but much less so than did DDT.

The reasons for the increase in mite population following treatment with DDT are briefly discussed [*cf.* **43** 261, etc.]. Orchard mites have numerous predators, of which the two most important in France are *Anthocoris nemorum* (L.) and *Orius minutus* (L.), but it is not certain that the effect is due solely to the destruction of these, since DDT has also been thought to increase mite fecundity [*cf.* **43** 341]. The effect on *E. lanigerum* is apparently due to destruction of its parasite, *Aphelinus mali* (Hald.).

It is concluded that lead arsenate should be preferred to DDT for the control of *C. pomonella* on apple, though one application of DDT can be

made in case of late infestation, without affecting the mite population. If it is desired to use DDT throughout, an acaricide should be added. When infestation has already occurred and winter eggs are numerous, DNC in oil is recommended for winter treatment; it should be applied as late as possible before hatching to give the maximum effect. Spring treatment with acaricides can be combined with the normal fungicidal sprays, systemic phosphorus products being recommended. Repeated treatments with non-systemic acaricides are not advised, since they destroy predators, and a single application of parathion at petal-fall is thought to be sufficient, with the action of natural enemies, to hold infestation in check.

BONNEMAISON (L.) & JOURDHEUIL (P.). **L'altise d'hiver du colza** (*Psylliodes chrysocephala* **L.**).—*Ann. Epiphyt.* **5** (1954) no. 4 pp. 345–524, 79 figs., 5 pp. refs. Paris, 1955.

Damage by insects to oil-bearing crucifers, particularly winter rape, has greatly increased in France since the cultivation of these on a large scale was extended in 1941. *Psylliodes chrysocephala* (L.) was not injurious until the winter of 1948–49, when conditions were particularly favourable for its development, but it caused very severe damage to rape in that and the following season. As little was known of its bionomics or control in France, investigations were made in the laboratory and in the field near Paris in 1950–53. The synonymy and distribution of the flea-beetle, including its varieties, and the wild and cultivated crucifers attacked by it are reviewed, and descriptions are given of all stages and the damage caused; almost all individuals collected in the field belonged to the typical variety.

The following is based on the authors' summary of the results. The adults first emerged from their aestivation quarters between 20th August and 25th September in different districts and years, according to local climatic conditions. Emergence began after rain and was completed in 10–15 days if heavy rain in the second half of August was followed by high temperature, but continued for more than a month in dry, cold or cloudy weather. They were active at temperatures between 12 and 25°C. [53·6 and 77°F.], pairing and feeding on the leaves of rape and wild crucifers, dispersed on sunny days, covering distances of up to about 2½ miles by flight, and settled on the seedlings of winter crucifers, especially at the edges of the fields and in damp sites, where they attacked the young leaves, stalks and collars of the plants. The period of dispersion ended when the majority of the females had reached sexual maturity. Experiments in the laboratory showed that an insufficiency of food delayed maturation of the ovaries, though the beetles survived for 10–15 days without food. Most of the females began to oviposit about 10–15 days after emergence from aestivation, usually between 10th September and 20th October. The eggs were laid in small groups on the surface of the soil or in cracks round the plants and were occasionally found singly on the collar and petioles.

In the laboratory, a maximum of 800 eggs was laid per female. Fecundity varied with climatic conditions and in 1951–52 averages of 64 and seven eggs were laid before and after winter, respectively; the autumn of 1952 was severe and an average of 130 eggs was laid between early February and mid-May of the following year. The threshold of development for the eggs was 2–3°C. [35·6–37·4°F.], and the larvae hatched in an average of 110 days at 5°C. [41°F.] and 48 days at 10°C. [50°F.]. Thus, if the autumn is mild, many hatch before winter, but if it is severe, the majority do not hatch until the end of winter, and the amount of damage to the seedlings varies accordingly. The three larval instars together lasted 37,

90 and 220 days at average temperatures of 15, 10 and 4°C. [59, 50 and 39·2°F.], respectively, and pupation occurred only at temperatures above 8–9°C. [46·4–48·2°F.]. First- and second-instar larvae mined the petioles of the lower leaves, and third-instar larvae mined the collar and stalks, sometimes reaching the terminal bud at the end of winter. Near Versailles, adult emergence began on 23rd May, 15th June, 1st June and 1st July in 1950, 1951, 1952 and 1953, respectively. The adults fed for a time without becoming sexually mature and then entered diapause, the period of feeding and diapause together lasting some 40 days. Individuals in diapause survived high temperatures and low humidities that were fatal to most of the adults that had only just begun to feed. The eggs survived cold but not dryness and the larvae were resistant to high and low temperatures, immersion in water and periods without food.

Experiments on the influence of temperature, humidity and food on oviposition indicated the existence of a rhythmic emission of the eggs, which were laid in groups of about 12–20, corresponding to the number of ovarioles. Females oviposited at between 2 and 28°C. [82·4°F.], but fecundity and length of life were greatly reduced above 16°C. [60·8°F.]. Between temperatures of 4 and 12°C. the rhythm of oviposition was maintained with regularity, the females ovipositing every 16–24, 8–10 and 4–5 days at 4, 8 and 12°C., respectively. It was not maintained at higher temperatures, the females dying without laying all their eggs, and below 4°C., females oviposited only once. A relative humidity of almost 100 per cent. and a moist substratum were necessary for regular oviposition. Among females reared in normal conditions (15–17°C. [62·6°F.] and 70 per cent. relative humidity), two periods were observed between early September and mid-April in which very few eggs were laid, but there was usually no interruption in more favourable conditions (4–12°C. and 90–100 per cent. relative humidity), though mortality was high at times corresponding to these two periods. A rise in temperature did not result in an increase in the average number of eggs laid or in the amount of feeding. Climatic and other factors affecting the density of larval and adult populations and the damage caused at different times of the year are discussed in some detail, and a method is described for calculating the probable size of the larval population in November. Damage is likely to be severe when, for some 20 days following the beginning of oviposition, the average temperature is at least 17°C. and the sum of effective temperatures (the threshold being 7°C. [44·6°F.]) is more than 290 day–degrees C. before winter.

The parasites of *P. chrysocephala* are reviewed from the literature. In November in 1951 and 1952, 0·4 per cent. of the larvae near Versailles and Angerville were parasitised by the Ichneumonid, *Temelucha carinifera* (Thoms.), and in 1951, *Diospilus* spp. (of which about 6 per cent. were *D. morosus* Reinh. and the remainder an undescribed species close to *D. capito* (Nees)) parasitised 80, 10 and 3 per cent. of the second- and third-instar larvae near Vaux-sur-Seine, Rheims and Angerville, respectively. In March 1953, near Versailles, about 60 per cent. of the larvae, most of which were then in the first instar, were parasitised by an undescribed species of *Thersilochus*, which was the only parasite of real importance. At an average temperature of 16°C., adults of *Temelucha* and *Diospilus* emerged just before those of *Psylliodes*, and in the field, they probably appear during May. Adults of *Thersilochus* remained in diapause in the pupal cocoons until the end of winter. Prepupae and pupae of *Psylliodes* were attacked in small numbers by nematodes, and the adults by fungi and gregarines.

The control measures recommended are primarily cultural. In districts in which the adults emerge early, winter rape should be sown in the first

ten days of September, so that the seedlings do not show above ground while the adults are dispersing. Where the adults emerge late, sowing should begin early so that the seedlings are well developed by the time of attack. Insecticides should be used only where emergence occurs at an intermediate date. The stubble should be ploughed up immediately after harvest, so that the fallen seeds germinate and produce a trap crop on which eggs are laid. These and the resulting larvae can be destroyed by ploughing in mid-October or later. In experiments, good protection against attack by adults of *P. chrysocephala* and *Phyllotreta* sp. up to the appearance of the third leaf was given by coating the seeds with 2·5 per cent. by weight of a product containing at least 50 per cent. lindane [almost pure γ BHC]. Excellent control of the adults was given by dusts of 5 per cent. DDT, 8 per cent. BHC, 1–1·25 per cent. lindane and 0·5 per cent. parathion, all at 18–22·5 lb. per acre, and sprays of 0·36 lb. aldrin, 0·27 lb. dieldrin, 0·72–0·9 lb. DDT, 1·08–1·35 lb. BHC, 0·162–0·18 lb. lindane, or 0·09–0·135 lb. parathion in 27–36 gals. per acre. Treatments should be applied a few days after the arrival of the first adults in the field. Larvae, especially those in the early instars, were controlled by parathion at 0·03 per cent. and 0·022 per cent. in suspension and emulsion sprays, respectively, and lindane at 0·02 per cent. Sprays should be applied in fine weather at about 10°C. at the end of October and should be used only if populations average at least 4–5 larvae per plant.

Boselli (F.). **Prove di lotta mediante elicottero contro il bombice dispari (*Lymantria dispar*) e il bombice gallonato (*Malacosoma neustria*) nelle sugherete della Sardegna.** [Experiments with a Helicopter against *L. dispar* and *M. neustria* in Cork-oak Groves in Sardinia.]—*Ann. Sper. agr.* (N.S.) **9** no. 3 suppl. pp. xvii–l, 3 refs. Rome, 1955. (With a Summary in English.)

Great damage is caused to cork oak (*Quercus suber*) in Sardinia by *Lymantria dispar* (L.) and *Malacosoma neustria* (L.), at least two thirds of the oaks, which cover more than 111,000 acres, being defoliated each spring by the larvae of these two moths. Larvae of *L. dispar* hatch about mid-April in the plains and during the first ten days of May in the mountains, and those of *M. neustria* some 15–20 days earlier. Severe attacks by *L. dispar* continue for 10–12 years, in contrast with the two- or three-year cycles usually recorded from the Italian mainland, and the very large numbers of larvae migrating in search of food in the second half of May and early June necessitate the evacuation of men and animals from affected areas. The attack results in total loss of the acorns, which are an important source of food for pigs, a reduction of more than half in the annual growth of cork, and difficulty in the removal of the cork, since new cells are not produced.

A preliminary test on the control of the larvae was made in 1950. On 5th June, a spray of 5 per cent. DDT in oil was applied from a helicopter (considered the only practical means of application under conditions in Sardinia) at the rate of 0·9 gal. per acre to about 75 acres of cork oaks. At that time, most of the larvae of *M. neustria* had already pupated, but those of *L. dispar* were in the fourth and fifth instars and therefore at their most active. The trees had largely been defoliated, and great numbers of larvae were crawling on the ground. On the following day, no crawling larvae were found, numerous large larvae on the ground were dead or dying, and feeding on the trees had ceased. The insecticide had no phytotoxic effects, and further examination on 9th June confirmed the good results obtained.

In 1951, an emulsified solution of 5 per cent. DDT was compared with the oil solution and the rate of application was increased to 1·035–1·35 gals. per acre. Treatment should have been applied between 10th and 25th May to prevent defoliation and save the acorn crop in the experimental area, but this was not possible. The sprays were applied by helicopter to about 1,500 acres between 6th and 12th June, mainly to groves at about 1,625 ft. above sea level, where the trees had not yet been defoliated, though they were infested by large numbers of young larvae. Excellent results were given by both sprays, the treated trees remaining green, whereas untreated stands round them were defoliated. The cost of the treatment is shown to be extremely low.

TORRENT (J. A.). **Oak Tortrix and its Control in Spain.**—*FAO Plant Prot. Bull.* **3** no. 8 pp. 117–121, 1 fig., 1 map. Rome, 1955.

Holm oaks (*Quercus ilex*) in Spain are severely damaged by *Tortrix viridana* (L.) and are also infested in some areas by *Malacosoma neustria* (L.) and *Lymantria* (*Porthetria*) *dispar* (L.). As a result, the production of acorns, which are used as food for livestock, is reduced by about three quarters. *T. viridana* overwinters in the egg stage. The larvae hatch in early spring and enter the buds; as these open, they feed on the young leaves, forming shelters by webbing them together, and on the flowers, so that no acorns are produced. They pupate after 3–4 weeks between the webbed leaves or in a rolled leaf, and the adults emerge 2–3 weeks later. The eggs are laid on young twigs, under a protuberance, in a cavity or at the junctions of branches. The damage caused by *M. neustria* is less severe, for though the larvae in the later instars feed on the older leaves, they cause less injury to the shoots and flowers, so that some fruiting occurs. *L. dispar* was formerly injurious over a wide area, but is now restricted to small districts within the range of *T. viridana* and has recently migrated towards the periphery of the peninsula, probably as a result of competition by the latter. Outbreak areas of *T. viridana* and important foci of infestation by *L. dispar* in Spain are shown on a map.

Control measures against *T. viridana* are best applied while the larvae are in their shelters, over a period of some 20 days between late March and early May. Sprays and dusts must be applied in fine particles so as to penetrate the shelters, and concentrated sprays are preferable to dilute ones, as water is not always readily available. Power sprayers and dusters and aeroplanes of various types were tested for their application and it is concluded that a light power duster is the most economical and practical machine for Spanish conditions. Dusting should be carried out only when the air is almost completely calm, in the early morning or late afternoon. DDT is very effective, provided that 95 per cent. of the dust passes a 200-mesh sieve, and it gave 95–99 per cent. mortality of the larvae when a 10 per cent. dust was applied at 7·2–10·8 lb. per acre, the diluent being kaolin. In the spring of 1954, treatment of infested groves over a considerable area in southern Spain resulted in high yields of acorns, even where no crop at all had been obtained for many years.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **3** no. 8 pp. 125–127, 1 ref.; no. 9 pp. 140–143, 1 fig., 3 refs. Rome, 1955.

C. G. MacNay (pp. 125–126) gives notes on insects that were recorded from Canada for the first time in 1953, but are not new to North America.

They include *Bruchus brachialis* Fhs., which was found breeding in the seeds of hairy vetch (*Vicia villosa*) in British Columbia and was intercepted in vetch seed for export grown in Ontario, the Aphid, *Pemphigus balsamiferae* Williams, which had been taken on lettuce in Manitoba in previous years but not identified, and *Scaptomyza apicalis* Hardy, which was collected on the leaves of turnip in British Columbia and on radish in Ontario and Quebec and is believed to have been present for some time.

W. J. Hall (pp. 126–127) reports that the Eriophyid, *Acaphylla steinwedeni* Keifer [*cf. R.A.E.*, A **33** 111], was collected on tea in Malaya for the first time in 1954, though Keifer has received specimens from tea elsewhere in Asia. Larvae of *Hellula phidilealis* Wlk., which has hitherto been thought to be restricted to America, were observed on cabbage in Sierra Leone in 1955. This Pyralid is thought to have been only recently introduced into Africa. A severe outbreak of the Hispid, *Trichispa sericea* Guér., occurred on irrigated rice at low altitudes in Swaziland in March 1955, and larvae of the Pyralid, *Ampycodes pallidicosta* (Hmps.), were found boring in the stems. Neither has previously been recorded in that territory, though both are known in other parts of Africa.

J. A. Whellan (pp. 142–143) reports that *Trogoderma granarium* Everts, which has been recorded from Northern Rhodesia, was found in Southern Rhodesia for the first time in 1955, infesting a mixed batch of stored beans originating from various districts and kept in a storehouse at Bulawayo that also contained beans from Bechuanaland. The severity of the attack suggested that it may have been of more than one year's duration.

HAFEZ (M.). **Studies on *Tachina larvarum* L. (Diptera, Tachinidae). I. Preliminary Notes.**—*Bull. Soc. Fouad Ier Ent.* **37** pp. 255–266, 1 fig., 30 refs. Cairo, 1953. **II. Morphology of the Adult and of its early Stages.**—*T. c.* pp. 267–304, 61 figs., 24 refs. **III. Biology and Life-history.**—*T. c.* pp. 305–335, 11 figs., 16 refs.

The investigations recorded in this paper were carried out to assess the importance of *Tachina larvarum* (L.) as a parasite of *Prodenia litura* (F.) on cotton in Egypt [*cf. R.A.E.*, A **41** 415]. The first part contains a review of the synonymy of *T. larvarum*, its distribution in the world and in Egypt and its hosts, together with a translation into English of Meigen's description of the adults. This Tachinid occurs throughout Egypt southward as far as Assyout, its range apparently coinciding with that of *P. litura*. Field collections indicated that the latter is its chief host, though *Laphygma exigua* (Hb.), *Autographa* (*Plusia*) *gamma* (L.), *A.* (*P.*) *circumflexa* (L.) and *Anadiasa undata* (Klug) were also attacked. Eggs were deposited on larvae of *Agrotis ypsilon* (Hfn.) in cages, but the parasite larvae failed to penetrate the integument and died in a few hours.

The second part comprises detailed descriptions of all stages of *T. larvarum*, and notes on the rearing methods adopted.

Field and laboratory studies on the life-cycle of *T. larvarum* are described in the third part. Pairing usually began 1–2 days after emergence, and the preoviposition period lasted 1–6 days. Eggs were laid on any part of the *Prodenia* larva, especially the dorsal region, the females laying up to 53 eggs per day under cage conditions. In the field, 1–14 eggs were found per host larva, 1–2 being the usual number. Females survived for 1–7 days after they had ceased ovipositing. The egg, larval and pupal stages lasted 4–27, 8–16 and 8–35 days, respectively, in the field and 3–10, 6–10 and 7–16 days in the laboratory, according to temperature

[*cf.* 22 674]. The larvae entered the host almost immediately after hatching and if unable to do so died from desiccation. They fed on the body fluids and fat-body in the first two instars and on the internal organs in the third. Pupation usually took place in the soil, but when there were several parasites in one host, all but the oldest usually pupated within it. Complete development lasted 32 days when there was only one parasite per host, and 28 days when there were two.

The average total number of eggs deposited per female was about 149, and the average number of host larvae attacked per female about 42. There was an inverse correlation between the average number of eggs deposited and the number of parasites that had developed in the same host with the female, but no correlation with the survival period of the female. Unfertilised eggs failed to hatch. The adults survived for 5–97 days with food and 2–5 without; the survival period was directly correlated with temperature, females survived longer than males, and the two sexes were equal in numbers. *Prodenia* larvae in the last three instars were preferred for oviposition, though younger ones were occasionally attacked; eggs deposited on all larvae except those in the sixth instar were lost during moulting. Parasitised larvae and newly formed pupae usually showed no external symptoms of parasitism, but older pupae became sluggish and elongated in form. Superparasitism was common, up to four adult parasites being obtained from a single host. About 15 overlapping generations occurred during the year, and the parasites were most abundant during September–October. Parasitism was low in June–July, reached a maximum of 7·1 per cent. in September and declined to a minimum in December; on one occasion, it was as high as 34 per cent. in October. It is concluded that *T. larvarum* is of little importance in controlling *P. litura*, the reasons for this including random oviposition and loss of many of the eggs, difficulty in entering the host, inferiority in competition with other internal parasites, and some parasitism of the puparia in the soil by *Dirhinus giffardii* Silv.

Fahmy (I.). **Olive Pests hitherto unrecorded from Egypt (Lepidoptera: Tineidae).**—*Bull. Soc. Fouad Ier Ent.* **37** pp. 487–488. Cairo, 1953.

The two insects here recorded from olive in Egypt for the first time are *Margaronia* (*Glyphodes*) *unionalis* (Hb.), which was taken at light in several districts prior to 1931 and has since damaged olives on the coast at one of them, and *Prays oleellus* (F.), which was not previously known in Egypt and caused extensive damage to olive nursery stock and crop trees in several districts. The larvae of the latter were most abundant during January–March, when they attacked the terminal buds; flower buds and flowers were attacked in April and May, and the fruits from July onwards. A preferred pupation site was the lower surface of the leaves of suckers at the bases of the trees, close to the soil, where conditions are moist. Damage was checked by control measures applied against *Dacus oleae* (Gmel.).

Menezes Mariconi (F. A.) & Iba (S.). **A mosca do Mediterrâneo.** [The Mediterranean Fruit-fly.]—*Biológico* **21** no. 2 pp. 17–32, 1 fig., 14 refs. São Paulo, 1955.

Ceratitis capitata (Wied.) causes very severe damage to the fruits of many cultivated and wild plants in Brazil. The more important of these,

the distribution of the fruit-fly there and elsewhere, its bionomics and methods of control are reviewed, and the adults and larva are briefly described. The losses are particularly great in São Paulo, where development of the fly is continuous, 8–10 generations a year occurring at Piracicaba. Coffee is heavily attacked, and after harvest the flies migrate from it in large numbers to neighbouring late oranges. These should therefore not be grown near coffee plantations, and wild host fruits near orchards should be destroyed wherever possible. In 1937, *Tetrastichus giffardianus* Silv. was introduced into São Paulo and released against *C. capitata* [*cf. R.A.E.*, A **27** 34; **29** 344], but it did not prove entirely effective. It is hoped that *Syntomosphyrum* (*Melittobia*) *indicum* Silv., which was introduced in 1954, also from Hawaii, and is being reared in the laboratory, will give better control.

The results obtained with sprays of organic insecticides against *C. capitata* are briefly reviewed from the literature [*cf.* **41** 422], and accounts are given of three experiments with them in 1951–53. In 1951, suspension sprays containing 0·2 per cent. toxaphene, 0·03 per cent. γ BHC or 0·25 per cent. DDT, all with the addition of molasses as an attractant, reduced the percentage of injured fruits to 5·6, 6·8 and 12·2, respectively, whereas similar sprays containing 0·02 per cent. parathion or 0·008 per cent. parathion and 0·16 per cent. toxaphene gave poor results. In 1952–53, when various organic insecticides were tested with unrefined sugar on guava, an emulsified solution of 0·056 per cent. γ BHC gave the most promising results, with an average of 22·2 per cent. of the fruits infested at the second picking and fewer at the first and third. In 1953, orange trees were sprayed four times between 30th July and 4th September with emulsion sprays containing 0·056 or 0·112 per cent. γ BHC and 0·4 or 0·8 per cent. toxaphene. The first application was made after infestation had begun, and no attractant was included, which is held responsible for the very poor results given by all treatments. It is concluded that until further experiments have determined the organic insecticides most suited for the control of *C. capitata*, other methods of control are preferable.

DE TOLEDO (A. A.). **Resultados de três ensaios de combate químico ao *Cosmopolites sordidus* Germ. bróca do rizoma da bananeira.** [Results of three Experiments on the chemical Control of *C. sordidus*, the Banana Borer.]—*Biológico* **21** no. 4 pp. 57–63, 5 refs. São Paulo, 1955.

Following tests in which soil treatment with organic insecticides gave promising results against *Cosmopolites sordidus* (Germ.) on banana in Brazil [*cf. R.A.E.*, A **42** 54], further experiments were begun in 1951 or 1952. In one begun in 1952, wettable powders were applied in plots of infested plants seven months old to give 1 or 2 gm. γ BHC or chlordane or 2 or 4 gm. toxaphene per stool. The treatments were repeated twice at intervals of five months, and the rhizomes were examined 15 months after the last application. At that time, the numbers of suckers produced per stool were 9·5, 8 and 7 in plots treated with the three insecticides, respectively, as compared with 9 for no treatment, and the percentages of rhizomes attacked were 1·4, 0, 7·6, 17·5, 39·9 and 12·2 for the six treatments, respectively, as compared with 64·8.

In the second experiment, carried out in 1952–54, rhizomes of a variety very susceptible to attack by *C. sordidus* were freed from infestation and planted in holes. Immediately after planting and then at intervals of three months, the holes were watered with suspensions of wettable powder

to give 200 mg. toxicant per stool per application. Examination of the rhizomes three months after the last treatment showed that the percentages attacked were 7·7, 7·9 and 32·3 for BHC, aldrin and dieldrin, respectively, and 3·2 and 14·3 for 1:1 mixtures of BHC and dieldrin and BHC and aldrin, as compared with 84 for no treatment. All treatments gave highly significant control, the difference between the mixture of BHC and dieldrin and dieldrin alone was highly significant, but there was no significant difference between BHC alone, aldrin alone and the mixture of BHC and aldrin. It is thought that there may have been some synergism between BHC and dieldrin.

In the third experiment, which lasted three years (1951–54), stools originating from disinfested rhizomes were dusted every 1, 2 or 3 months with BHC in talc or lindane [almost pure γ BHC] in fine sand to give 120 mg. γ BHC per stool. The percentages of injured rhizomes at the end of the experiment were 0, 14·2 and 6·5 for BHC every 1, 2 and 3 months, respectively, as compared with 71·9 for no treatment, and 15, 28·6 and 54·5 for lindane.

Hoy (J. M.). **The Biology and Host Range of** *Neoaplectana leucaniae*, **a new Species of Insect-parasitic Nematode.**—*Parasitology* **44** no. 3–4 pp. 392–399, 5 figs., 10 refs. London, 1954.

A description is given of the various stages of the nematode, *Neoaplectana leucaniae*, sp. n., examples of which were found in a dead pupa of *Leucania acontistis* Meyr. at the base of tussock grass at Seafield, New Zealand in 1945 and in dead and dying larvae of a small tussock moth, *Crambus simplex* (Btlr.), at the same locality in 1947. Its life-cycle was found to resemble that of other species of *Neoaplectana* [*cf. R.A.E.*, A **29** 369]. Each female produced about 250 offspring, and a generation was completed in the insect host in 6–7 days at temperatures of 15·5°C. [59·9°F.] or higher. The hosts die a few days after becoming infested, but the nematodes continue to feed in their tissues. Ensheathed larvae escape when the cuticle of the host disintegrates and persist for long periods in the grass base until ingested by a new host. The nematode was successfully cultured on a medium of veal pulp, with preservatives, and its ability to infest insect hosts was not impaired by rearing on the medium for up to ten generations.

The value of *N. leucaniae* in controlling soil pests was tested in the laboratory by adding ensheathed larvae from dead hosts or from artificial cultures suspended in isotonic solutions to partially sterilised soil containing the insects. Third-instar larvae and adults of *Costelytra zealandica* (White) and six other Melolonthids were all parasitised by the nematode, which killed the larvae and adults in 2–4 and 9–14 days, respectively. Other soil insects attacked included larvae of *Oxycanus cervinatus* (Wlk.), Elaterids and a weevil; earthworms in contaminated soil were alive and apparently healthy after 90 days. In another laboratory experiment, to determine the possibility of natural spread of the nematode by means of infected beetles, 100 adults of *C. zealandica*, provided with rose leaves as food, were confined in moist sterilised soil containing ensheathed larvae; 22 of 70 that died and three of 30 trapped while leaving the soil were found to be infested with *N. leucaniae* and the latter all died within 17 days. In pot experiments in which the temperature and moisture content of soil containing ensheathed larvae fluctuated and host populations were low, no nematode larvae were recovered after three months, though those of *N. glaseri* survived for 4½ years under similar conditions. In view of this lack of persistence in the soil, artificial culturing of *N. leucaniae* was discontinued.

Smith (K. M.) & Xeros (N.). **A comparative Study of different Types of Viruses and their Capsules in the Polyhedroses and Granuloses of Insects.**—*Parasitology* **44** no. 3–4 pp. 400–406, 2 pls., 22 refs. London, 1954.

K. M. Smith & R. W. G. Wyckoff recently demonstrated the existence in larvae of *Arctia villica* (L.) and *A. caja* (L.) of a polyhedral disease with spherical virus particles about 65 mμ in diameter instead of rods, of which the polyhedra dissolve only partially in weak alkali, leaving a honeycomb-like shell pitted with round holes. The present authors found that these polyhedra were confined to the cytoplasm of the cells of the mid-gut [*cf. R.A.E.*, A **43** 303]. Other Lepidoptera of which the larvae are attacked by cytoplasmic polyhedroses include *Bombyx mori* (L.), *Abraxas grossulariata* (L.) and *Phlogophora meticulosa* (L.). Great difficulty was experienced in seeing the virus in polyhedra treated with solutions of sodium carbonate and examined by means of the electron microscope, but when thin sections of infected larvae of *P. meticulosa* were examined, the polyhedra were found to consist of a mass of spherical bodies, each about 60 mμ in diameter and composed of a number, usually four, of very small units, in a matrix of polyhedral protein; both composite bodies and small units also occurred loose in the cytoplasm. The spherical bodies were about the same size as those from *Arctia villica* (which may also be compound), and might be compared to the bundles of three or more virus rods surrounded by an intimate membrane and enclosed in a capsule that occur in larvae of *Lymantria monacha* (L.) and *Abraxas grossulariata* infected with nuclear polyhedroses. The capsules enclosing the virus rods or, as in *B. mori*, each single rod, are themselves enclosed in a mass of polyhedral protein, which can be regarded as an outer capsule.

A similar structure of a single virus rod surrounded by an intimate membrane enclosed within an inner and an outer capsule appeared to exist in granules from larvae of *Natada nararia* (Moore) from Ceylon infected with a granulosis disease. When the granules were dissolved in sodium-carbonate solutions, the only membrane observed during the process was the one surrounding the virus. The granules are formed in the nuclei of the hypodermis and fat-body, and the appearance of the diseased cells, which is similar to that found by earlier investigators in *Junonia coenia* Hb. and *Sabulodes caberata* Gn. [*cf.* **39** 318], is described. The nucleus becomes greatly enlarged and aggregates of granules develop within it, but there are no central chromatic mass and empty ring zone as in cells infected with nuclear polyhedroses. The inclusion bodies in granulosis diseases [**39** 318; **40** 159; **43** 410] are much smaller than virus polyhedra, and previous authors considered that each might contain only one virus rod. From a consideration of the literature and published electron micrographs, it is concluded that the inner capsule contains one rod in the granuloses of *J. coenia*, *S. caberata* and *Pieris rapae* (L.) and two in those of *Peridroma saucia* Hb. (*margaritosa* (Haw.)), *Choristoneura* (*Cacoecia*) *murinana* (Hb.) [**38** 348] and *Eulia* (*Argyrotaenia*) *velutinana* (Wlk.).

The authors demonstrated in earlier work with larvae of *B. mori* and *Tineola bisselliella* (Humm.) infected with polyhedroses that the inner capsule is not a developmental membrane, but is acquired after the virus rod has been formed and freed into the ring zone. It is distinct from the membrane surrounding the virus, and the spherical bodies considered by Bergold [**38** 348] to be developmental forms are in fact bundles of half-length rods enclosed within an inner capsule; species in which this was observed included *L. monacha*, *L. dispar* (L.) and *B. mori*, and similar forms were also seen in the granuloses of *N. nararia*, *C. murinana* and *E. velutinana*. The proportion of half-length rods present varied from

species to species, and it is suggested that the rods tend to break and that full- and half-length rods are the most stable. On the basis of these findings, the authors consider that the evidence of a life-cycle provided by Bergold is invalidated.

LANGDON (R. F. N.) & CHAMP (B. R.). **The Insect Vectors of** *Claviceps paspali* **in Queensland.**—*J. Aust. Inst. agric. Sci.* **20** no. 2 pp. 115–118, 4 refs. Sydney, 1954.

Paspalum dilatatum is heavily infested by the fungus, *Claviceps paspali*, over wide areas in south-eastern Queensland, and the affected plants produce a sticky exudate, which is attractive to insects. The conidia of the fungus are embedded in the exudate, which prevents their transport by wind, and it seemed possible that insects might be involved in their dispersal. Arthropods collected from heavily infested stands in 1951–52 were examined for the presence of conidia adhering to their bodies, and their intestinal contents and excreta were examined for ingested conidia. The species in which ingested conidia were found, which are shown in a table, comprised the Muscid, *Pyrellia coerulea* (Wied.), which was much the commonest, small numbers of eight other Diptera, the wasp, *Rhopalidia gregaria* (Sauss.), the Ichneumonids, *Paniscus* spp. and *Lissopimpla semipunctata* (Kby.), a Braconid, a Tettigoniid and a Pyralid. Conidia were found on the bodies of spiders, ants, Aphids, Coccinellids, Acridids, Tettigoniids and two species of thrips.

Pyrellia coerulea was observed feeding on the exudate in all the stands of infested *Paspalum*, but it also visited young, healthy inflorescences. Conidia were present both in the excreta of flies that had fed on the exudate and in food regurgitated by them, and they were recovered for up to seven days from the excreta of flies that were caged after feeding on the exudate and supplied only with diluted honey. The viability of conidia taken from the excreta or gut of *P. coerulea*, *R. gregaria* and two unidentified flies did not differ appreciably from that of conidia taken directly from the plants; 3–6 per cent. of those in the excreta of flies caged for 12 hours after feeding on the exudate germinated after 14 days. Adults of *P. coerulea* and Aphids with exudate on their legs, both collected from infested plants, transmitted the fungus to *Paspalum* plants when confined on the open inflorescences in large glass tubes for two hours; symptoms developed after about a week, whereas control plants remained healthy. In another test in which excreta of *P. coerulea* containing conidia were placed on open inflorescences on a plant in the greenhouse and sprayed with water, symptoms also developed after a week. It is concluded that *P. coerulea* is the most important insect concerned in the wide dissemination of the fungus, but that thrips and Aphids may carry conidia from one floret to another.

SHCHEGOLEV (V. N.). Ed. **The Entomologist's Glossary and Reference Book.** [*In Russian.*]—9 × 5¾ ins., 451 pp., text illus., many refs. Moscow, Gosud. Izd. sel'skokhoz. Lit., 1955. Price 18 *rub.* 65 *kop.*

This glossary is for the use of those concerned primarily with the protection of crops in the Soviet Union from insects and mites. The entries include the usual technical terms, the main pests of crops in the Soviet Union or neighbouring countries, arranged under their popular names with their scientific names and information on their bionomics and control, chemicals that are used in crop protection and apparatus for applying them, the main crop plants, with the pests that attack them, and biographical notes on Russian entomologists.